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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

> "To the solid ground
> Of Nature trusts the mind which builds for aye"—WORDSWORTH.

NO. 274, VOL. 11] THURSDAY, JANUARY 28, 1875. [PRICE FOURPENCE

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The Publishers beg to announce th[illegible]ing to the largely increased circ[illegible]ion of "NATURE," Advertisements must reach the office not later than 12 *a.m. on Wednesdays.*

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By Order of the Council.—The MEETING of February 3 will take place at 8 p.m. instead of 4.15. Paper to be read, "On the Classification of MSS., chiefly in relation to the Classed Catalogue of the British Museum." By WALTER DE GRAY BIRCH, Esq.

4, St. Martin's Place, W.C., 1875. W. S. W. VAUX, Secretary.

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THE MARQUIS OF SALISBURY ON SCIENTIFIC EDUCATION

THE scientific world is much indebted to the Marquis of Salisbury for the clear and powerful speech on the value of scientific education which he delivered in Manchester on Friday last. It is a satisfactory sign of the times when a statesman of his position and intellectual standing acknowledges the claims of science to a place in the higher education of the country equal to that of the older studies. Whilst adverting to the great strides which had been made respecting the elementary education of the country, Lord Salisbury does not forget that "the true key to the education of the lower classes is a love of knowledge on the part of the classes that are above them;" and he goes on to point out that in the district in which he was speaking, the secondary, and especially adult education, was well provided for. He passed a well-deserved encomium on the Owens College. Although the general instruction of the adult population by means of evening classes does not form the primary work of a College such as Owens, yet, placed as it is in the midst of a dense and busy population, it has found that there is much good work to be done in this direction.

In this service there can be no rivalry between Owens College and other institutions of a similar character; each has its own sphere, and, indeed, the truth is that if in large cities evening classes are to be of essential service, they must not be confined to one institution. For not only must the focus of instruction be near the men who are wearied with a hard day's work, but a different style of tuition naturally grows up in the various centres; one may, by natural selection, adopt one branch, and another another. Such a course is indeed the healthy development of a living organism which suits its growth to the conditions of its environment; and whilst it strengthens itself by so doing, it affords at the same time grateful sustenance and solace to those dwelling under its shadow. One of the great problems of the age, upon the successful solution of which much of our social and material prosperity depends, is indicated by the Marquis when he tells us that the truths of science should permeate the whole mass of the people. Evening classes such as we have referred to form one of the modes by which this may be accomplished. Another means of awakening the scientific interest of the people is by a widespread series of thoroughly trustworthy popular science lectures. Manchester has for some years taken a prominent position in this latter respect, and has been followed in this direction by the Gilchrist Trustees, who have established similar courses in the metropolis; whilst Liverpool, Glasgow, and other towns have recently determined to follow the same lead. The main object of such lectures is to interest more than to instruct, and we require, besides them, the general establishment of regular classes in which the subjects are thoroughly taught. Such classes are indeed established throughout the length and breadth of the country, thanks to the operations of the South Kensington Staff; and it is difficult to over-estimate the value of the scientific haul which year by year this network thrown from the metropolis gathers up. From the satisfactory and rapid growth of this system of science teaching, the time must necessarily arrive when the central agency should not be confined to the metropolis alone, but should be supplemented by local centres, each of which would probably be more conversant with the special wants of its district than the metropolitan institution could possibly be.

Good as all such evening and adult science instruction may be, its prosperity must depend on the existence and healthy growth of a higher class of teaching, such as that afforded by the various universities and colleges throughout the country. It is their problem to teach the teachers, and it is in the carrying out of this great task that Governmental assistance is imperatively required. By this assistance, however, we do not mean that institutions are to be at once artificially created; such a thing is just as impossible as to bring a full-grown man into the world at once, without his passing through all the stages of childhood. Each higher school will naturally select, if properly fostered, its own special direction of development, and it is absurd to suggest any operation by which such a natural growth should be cut down, like a Dutch garden, in order to improve its form.

We have left untouched the question of the endowment of research; but it is obvious that to endow the unremunerative manufacture of knowledge is more important than to endow teaching which is always more or less remunerative.

SOUTH AMERICAN TRAVEL

Travels in South America, from the Pacific Ocean to the Atlantic Ocean. By Paul Marcoy. Illustrated by 525 engravings and ten maps. Two vols. (London: Blackie and Son, 1875.)

The Amazon and Madeira Rivers: Sketches and Descriptions from the Note-book of an Explorer. By Franz Keller, Engineer. With sixty-eight illustrations on wood. (London: Chapman and Hall, 1874.)

Two Years in Peru, with Exploration of its Antiquities. By T. J. Hutchinson, M.A.I. With map and numerous illustrations. Two vols. (London: Sampson Low, 1873.)

WE notice these three works together, because to a considerable extent the first-mentioned embraces the ground gone over by the other two. Like Mr. Hutchinson, M. Marcoy devotes considerable space to the prehistoric antiquities and native populations of Peru, and, like Mr. Keller, the French traveller has much to say on the hydrography of the Amazon, on its fauna and flora, and on some of the numerous tribes that people the region contained within its vast basin. Of the three writers, M. Marcoy alone can be called a professional traveller,—at least, he appears as such in the present narrative; while Messrs. Keller and Hutchinson only took advantage of their vocation calling them to South America, to investigate what interested them in the particular regions which they visited. It is very gratifying to find men who do not profess to devote their lives to the advancement of scientific knowledge, so willing and competent as this engineer and this consul are to add to its sum. The number of such unprofessional—if we may so call them—advancers of scientific knowledge has in recent years been gradually increasing; and we hope that with improved systems of education, both in Europe and in America, systems in which a training in science will have a prominent place, such scientific volunteers will become more and more numerous. Considering the large number of Englishmen alone who occupy positions in our own colonies and other foreign countries, in the midst of districts of which we have very little accurate knowledge, what a rich harvest might be expected if only one half of them had the scientific training to be obtained at a German *Realschule!*

The dates of publication of the three works at the head of this article are somewhat misleading; the order in time of the respective travels is indicated by the sequence of the titles.

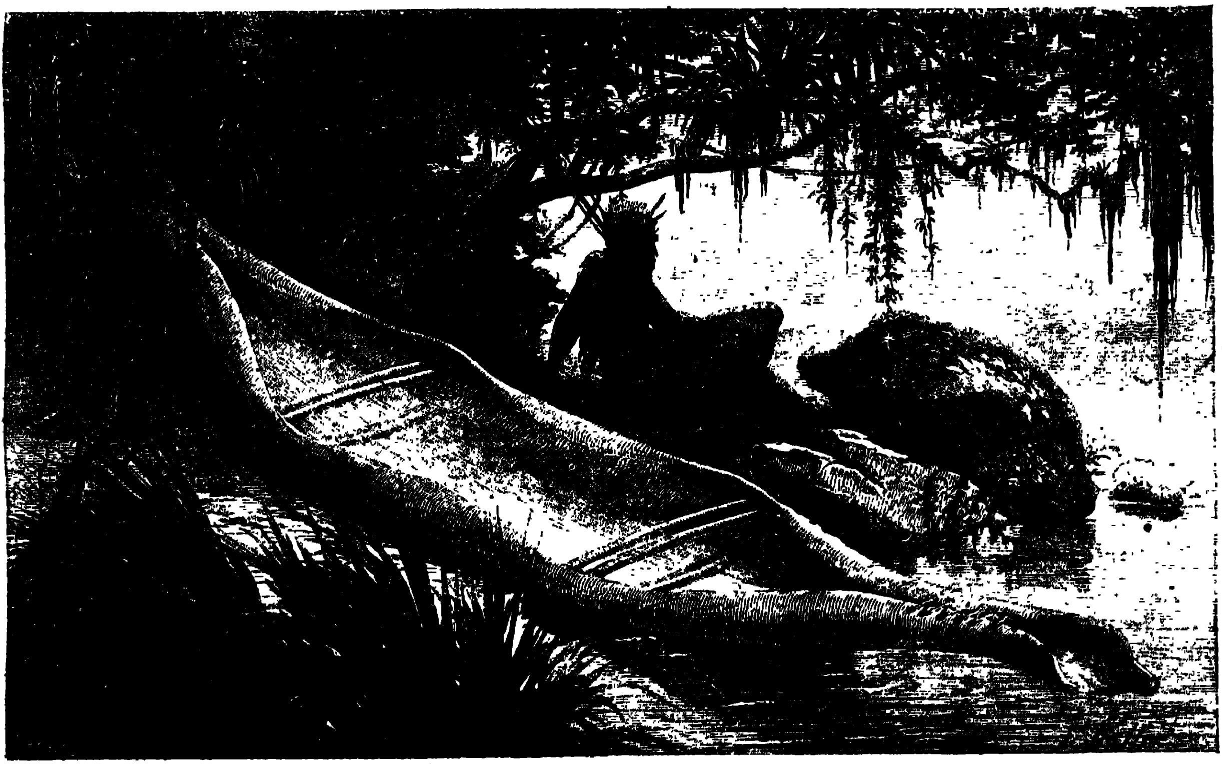

FIG. 1.—Bark Canoe of Wild Indians (Aráras and Caripunas).—Keller.

M. Marcoy's narrative is in some respects a puzzling one. It may be said, so far as his own journey is concerned, that there is not a single date in the whole book. Whether this be the author's fault, or that of the publishers of this translation of his work, we do not know; but we deem it rather a serious one if the work is put forth as the genuine narrative of a traveller who wishes to be regarded as a trustworthy observer and recorder of phenomena, many of which may alter in the course of a very few years. M. Marcoy's observations as to the condition of the prehistoric remains of Peru, of the condition of the peoples, both dominant and native, with whom he came in contact, of the state of rivers, of the fauna and even of the flora, will be deprived of no small amount of their value there is any doubt as to the date at which they were made. From internal evidence we conclude that the journey from Islay to Para was made during the twelve months following July either of 1847 or 1848; and we learn from St. Martin's recently published "History of Geography" that M. Marcoy was in the country about that time. But the work is thoroughly French from beginning to end, from the theatrical *pose* and costume of the author's portrait in the frontispiece to the final "Vale." We certainly believe that M. Marcoy made the journey across the South American continent about the year 1848, and that the work before us contains a narrative of what he heard and saw; but the author evidently studies effect so much, both in his illustrations and his style of writing, that one is apt to have a feeling that not unfrequently strict accuracy has been sacrificed, and that the author has given way to the very French failing of a love of exaggeration. This, we think, is particularly seen in the author's account of the French scientific expedition, in the company of which he performed part of his journey. His portrait of the "Count de la Blanche-Epine," as he calls the leader of the expedition, is evidently a caricature, and we fear the same may be said of several other portraits in the book; and whenever he refers to the Count—and he does so *ad nauseam*—it is invariably with so much bitterness, that one is apt to think the Count had snubbed the somewhat Bohemian but evidently sensitive traveller.

But that the narrative has been revised within the last few years, is evident from several passages. He refers to occurrences which took place in 1866; and while sailing down the Amazon he discusses the value of observations which must have been made years after his journey. Throughout the work the personal narrative is frequently so mixed up with information obtained by the author either at other times—for he was many years in South America—or at second hand, that it is often difficult to know where to draw the line; and thus one who is simply in search of a trustworthy narrative of observed facts is apt sometimes to feel insecure.

Moreover, we find from M. St. Martin's work, that "Marcoy" is really a pseudonym, the author's real name being Saint-Cricq. Why a veracious traveller should write under a pseudonym it is difficult to see; fancy Wallace, or Bates, or Livingstone, or Baker, or Payer, or Meyer doing so. Did "Paul Marcoy" fear the vengeance of the "Count de la Blanche-Epine?" That M. Marcoy intends his narrative to be taken *au sérieux* is evident throughout, from his elaborate and really valuable dissertations on the antiquities and original populations of Peru, their sources and migrations, followed up by similar dissertations on the various groups of tribes he passed through, his minute and careful geographical descriptions, especially in connection with the Amazonian river-system, and the many details he gives concerning the fauna and flora of the extensive region which he traversed. We hope the publishers in the next edition will at least, if they can, give the exact date of M. Marcoy's journey; let them be assured that, instead of detracting from, it will add to the value of the work, even though with regard to Peru and the Amazon there have been later explorers.

Notwithstanding these blemishes, the work must be regarded as, on the whole, a trustworthy narrative, containing a great deal of valuable information, especially on the tribes with which the traveller came in contact on the river Ucayali and its tributaries, and on the natural history of the regions he travelled through.

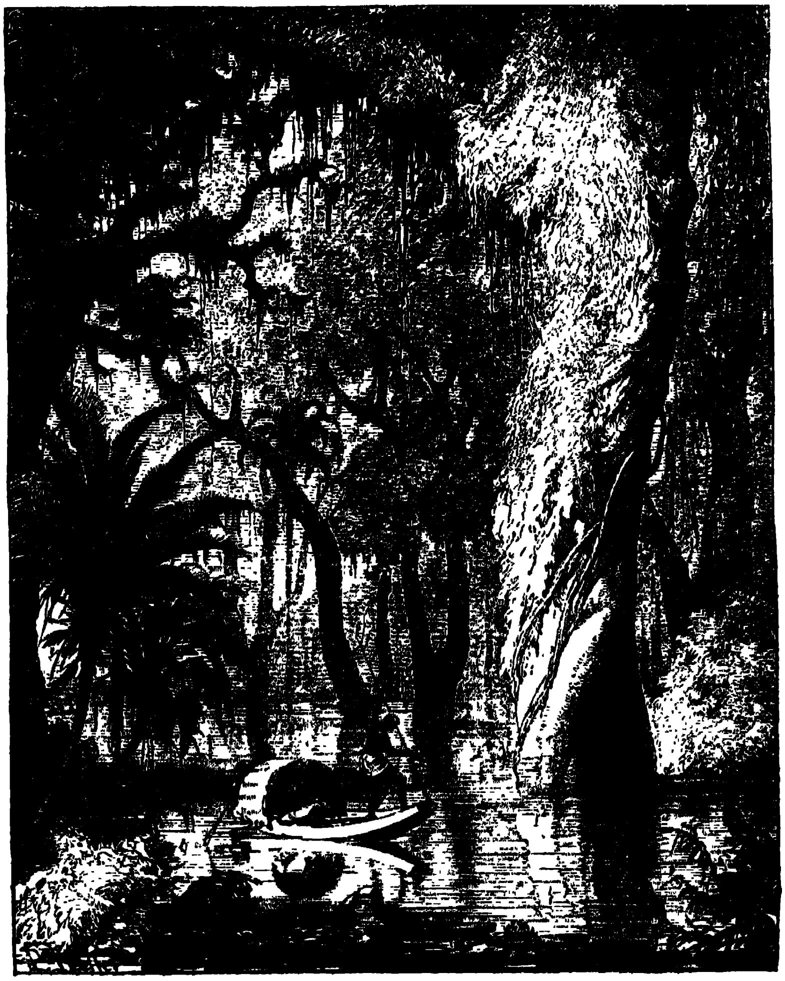

FIG. 2.—Submerged Forest.—Keller.

M. Marcoy's point of departure was the port of Islay, nearly under the 17th degree of south latitude. He tells us that his journey was undertaken as the result of a wager with the captain of an English vessel, that he would reach Para, in Brazil, by crossing the continent, as soon as the captain would sail to the same place round Cape Horn. As might be expected, he lost his wager. Still, considering, or because of, his simple equipment, and taking into consideration the frequent long stays he made at various places on his route, his journey, performed in a year and fourteen days, must be regarded as a wonderful feat. At the same time he managed to see a great deal that is worth recording. He went by Arequipa, the north end of Lake Titicaca, Acopia, Cuzco, to Echarati, on the Rio Quillabamba Sta. Ana, as he calls the river marked Urubamba in most maps, even in that of Barrera (1871) prefixed to Mr. Hutchinson's work. M. Marcoy is extremely particular about the courses and names of his rivers, and, as we have said frequently enters into long dissertations on the subject, giving minute details with much confidence. He is particularly confident as to the courses and names of the numerous rivers that unite to form the Ucayali. Near

Echarati, he embarked in a canoe on the Quillabamba or Urubamba, and sailing down this river and its continuation, the Ucayali, reached Nauta, opposite the mouth of the latter, on the Amazon; getting a boat at Nauta, Marcoy sailed down the Amazon to Barra, at the mouth of the Rio Negro, completing his journey from that point to Para in a sloop.

The first part of his journey after leaving Islay is dreary enough, over desert pampas and barren mountain regions, and the weary iteration of the trivial incidents in each day's journey becomes in the end positively tedious. In connection with Cuzco, the author gives considerable details concerning Peruvian antiquities, some of the remains of which he appears to have carefully and minutely studied, and of which he gives some valuable illustrations—sculpture, statuary, fortifications, pottery; and lastly, what professes to be a series of the thirteen Incas and their wives from Manco Capac downwards, who reigned over Peru from the foundation of Cuzco to the Spanish Conquest. They are beautifully executed, but we fear their historical value won't count for much. M. Marcoy has a very complete theory as to the peopling of America by the ancestors of the native races who at present inhabit America. He recognises two different types as including nearly all the peoples both of North and South America—the Mongolo-American type and the Irano-Aryan type, of which the former, the colonising or swarming element, as he calls it, is by far the more numerous. Both races, he seems to believe, entered America from Asia at a very remote period, probably by Behring Strait, which at the time of the migration he appears to think was bridged over by an isthmus. He endeavours to connect the Irano-Aryan type at least with the ancient civilisation of India and Egypt, with modifications and additions acquired by the migrants from the various peoples with whom they came into contact in their progress north-eastwards through Asia. The Quichuas, Aymaras, Antis, and Chontaquiros, tribes of Peru, he connects with this civilising element, as he calls it, to which he apparently attributes most of the wonderful monuments that now remain. That there are two distinct types among the native inhabitants of Peru the latest and most trustworthy researches seem to prove, as also that there has been more than one immigration from Asia, but that right across the Pacific, and not by Behring Strait; but that the Incas were the authors of the wonderful works of which so many remains still exist, seems in the highest degree doubtful. We fear the theories of M. Marcoy on this point will be considered rather wild by the scientific investigator, who we daresay will prefer the sober hypotheses of Mr. Hutchinson, based as they are on a broad basis of facts. But more of this when we come to the work of the latter.

M. Marcoy gives many interesting details concerning the social life of the various cities and towns of Peru through which he passed on his way to Echarati. The picture presented is on the whole a sad one, and we should hope that since he made his journey there has been a great reformation, and that since railways and steamers have brought the people more into contact with the busy world of Europe and North America, industry, morality, and education have attained a higher platform.

The real interest of M. Marcoy's journey begins when he launches on the river Quillabamba, probably the most tortuous river in the world, and so studded with rapids that navigation, except in canoes, is utterly impracticable. M. Marcoy gives much scattered information, helped considerably by the artistic illustrations, of the vegetation on the banks of this and the other rivers down which he passed. The traveller was nothing if not an artist; and the work before us, in the eyes of most readers, will derive half its value from the beautifully executed and graphic illustrations, which enable one to realise the scenes through which the author passed, better than any amount of description. So his sketches of the native Indians give one a good idea of the different types met with along his route. Most of these, we should think, are portraits, and some allowance, no doubt, must be made for the author's tendency to artistic exaggeration. Some of these portraits, as well as some of the sketches illustrating the social life and habits of the natives, we recognise as having been used (without acknowledgment) in a recent popular work on anthropology. This suggests the idea that the publication, so far as scientific purposes are concerned, is rather late; we should think it likely that whatever the work contains of value bearing on the ethnology, geography, and natural history of the Amazonian region, has already found its place in those sciences through the French edition.

Although the author enumerates many tribes to be met with on the Ucayali and its tributary rivers, the members of these tribes at the time he visited were very few, and the region through which he passed on his way to the Amazon appeared to be but thinly inhabited, notwithstanding the abundance of food, both vegetable and animal. Indeed, the native races of South America, like those of North America, seem to be dying out before the advance of the white man, though not so rapidly, for the simple reason that the spread of the white man over the southern continent is much more slow, and the whites themselves seem to be nearly as lazy as the Indians. Perhaps the fostering care of the Jesuit missionaries may also have helped somewhat in preventing the rapid extinction of the Indian tribes. These missionaries have been at work more or less ever since the Spanish conquest of Peru, and the "converts" may be counted by thousands, though M. Marcoy thinks, and he is not singular in the opinion, that the missionaries have succeeded only in producing a degraded type of Indian, differing from his heathen brother simply in having lost his independent spirit. M. Marcoy appears to be thoroughly acquainted with the history of the Jesuit missions in Peru, and one of the most pleasant episodes in his work is the account of his long stay at a mission station on the Sarayacu, a tributary of the Ucayali.

The tribes whom the author names as inhabiting the banks of the Ucayali and Quillabamba are the Quichuas, the Antis, the Chontaquiros, the Conibos, the Sipibos, and the Schetibos. Of these, only the first three, along with the Aymaras, and two or three tribes scattered through the valleys of Bolivia, does he recognise as representing his "Irano-Aryan" race. Most of the other tribes he believes represents his Mongol or Tatar race, the colonising element; while the Carib, Tupi Guarani, and other races, are in his opinion only various genera derived from the above-named mother families. We doubt whether this sweeping and easy way of grouping the American native races will stand the test of rigid ethnologic investigation; we suspect it will require much wider data than M. Marcoy had at his command to settle the question satisfactorily. The facts he gives, however, concerning the various tribes with which he came in contact, appear to us to be of considerable value. His descriptions of the peoples, the manners and customs, *physique*, traditions, movements, religious beliefs, vocabularies, &c., are all contributions to science, which the discriminating ethnologist will no doubt know how to make use of.

With regard to what must be considered as the proper source of the Amazon, M. Marcoy agrees so far with Mr. Squier, one of the latest writers on the subject, or rather with Dr. Santiago Tavara, of the Peruvian Hydrographic Commission, that it is not the Marañon. Dr. Tavara decided that as the Ucayali has greater volume and length than the Marañon, the former must be regarded as the Rio Madre del Amazonas. M. Marcoy had long before this concluded that as the Apurimac, a principal tributary of the Ucayali, is seventy-five miles longer than the Quillabamba or Urubamba, the upper part of the Ucayali, the former ought to be regarded as the real source of the Amazon. Several attempts have in recent years been made to discover if any of the many upper tributaries on the right bank of the Amazon could be made available for navigation by steamers, but, so far as we have learnt, with disappointing results, so that it is doubtful if any of these immense tributaries can ever be used as pathways for commerce.

During his slow progress down the Amazon, M. Marcoy frequently halted on its banks, visiting the mission stations, the half-civilised settlements of Brazilians and half-breeds, and the villages of the Indians. He also explored the mouths of some of the rivers flowing into the Amazon, and some of those curious natural canals which unite the main stream with many of its tributaries a considerable distance above the latter's *embouchure*. It is well known that the waters of some of the Amazonian tributaries, as the Rio Negro, are of a very dark colour, resembling coffee. We do not know that this has yet been satisfactorily accounted for; it can hardly, it would seem, be owing to the nature of the ground over which the rivers flow, as this is of very diverse kinds. M. Marcoy declares that when this water is looked at through a transparent vessel, it is perfectly limpid and colourless; only in cases where the current was slow or imperceptible, it had a brown tint. Animals of all kinds abound in and around these curious waters.

M. Marcoy made a careful exploration of the delta of the Purus, a large tributary on the right bank of the Amazon, by which he ascertained that the river has only one *embouchure*, the other openings being really only natural canals. M. Marcoy's knowledge of the hydrography of the south side of the Amazon seems to be clear and accurate, and is certainly extensive, and his frequent dissertations on the subject are worthy the attention of geographers, if they have not already gained it. One of the most valuable features of his work is the set of splendid maps which are prefixed, showing in minute detail the topography of his route.

We must leave M. Marcoy to find his way to Para, and accompany Mr. Keller in his journey up the Madeira. While we certainly think that in regard to the points to which we have referred the value of M. Marcoy's work is capable of being enhanced, still on the whole it must be regarded as deserving to occupy an honourable place among works of travel. It is essentially a popular work, and we hope it may have an extensive sale and many readers, as it contains a vast amount of really valuable information concerning the geography, topography, natural history, and ethnology of Peru and the Upper Amazon. Messrs. Blackie have done well in publishing an English translation, which has been remarkably well done by Mr. Rich.

(*To be continued.*)

MOGGRIDGE'S "HARVESTING ANTS AND TRAP-DOOR SPIDERS"

Supplement to Harvesting Ants and Trap-door Spiders. By J. Traherne Moggridge, F.L.S., F.Z.S. With specific descriptions of the Spiders, by the Rev. O. Pickard-Cambridge. (Reeve and Co., 1874.)

MR. MOGGRIDGE'S original work was reviewed in NATURE, vol. vii. p. 337, and we have already a mass of additional matter, paged continuously so as to form one volume when bound up with the first part. Only twenty pages are here devoted to the ants, yet we find several observations of great interest to the philosophic entomologist. Thus, the actions of lizards and tiger-beetles in attacking the ants were closely observed. The lizards only eat the winged males and females, but show great fear of the workers, always keeping out of their way; and the workers protect the winged ants by surrounding and swarming over them, so that the lizards can only occasionally dash at an outlying straggler. The Tiger-Beetle (*Cicindela*) devours the workers, but only attacks them with great precaution, keeping out of the way of the main body and seizing stragglers by a bite just behind the neck. If it fails to seize them in this exact spot it leaves go again, evidently knowing that if the ant's jaws once close on any part of its legs or antennæ they will never leave go, even after death. These observations apply to the two species of South European Harvesting Ants, *Atta structor* and *A. barbara*, and they furnish a clue to the use and purport of the large bodies of workers, which act as guards to the males and females. They also explain the use of the spines, hooks, and bristles with which so many of the weaker forms of ants are armed, as well as the occurrence of a proportion of soldiers—large-headed workers whose only function is to attack and drive away certain specially dangerous enemies. Some of these large-headed workers are essentially a huge pair of jaws with just enough body to carry them about, and whose sole object in life is to fasten on some special enemy and sacrifice themselves for the good of the community. The most important problem remaining for solution in connection with these harvesting ants is, how they contrive to keep the seeds in their granaries from germinating. Mr. Moggridge has proved that formic acid or its vapour has no influence, that the presence of the ants is necessary to prevent germination, but that their presence alone does not prevent it. Is it not probable that the whole secret consists in the ants continually using for food those seeds which begin to germinate, and that there always remain many seeds whose germination is delayed?

The remainder of the volume is devoted to Trap-door Spiders, many new species of which have been discovered, and much curious information obtained as to their habits. The spiders and their nests are illustrated by figures which are models of accuracy, and far surpass in delicacy and finish those of the first volume, good as those were. There are some interesting remarks about the British Nest-making Spider (*Atypus sulzeri*), which has very rarely been observed, but which, now attention is called to the subject, will no doubt be found to occur plentifully in the South of England. The new double-tubed and double-doored nest now first described is the perfection of insect architecture; and being constructed by a single insect is far more indicative of intelligence, mechanical skill, and reasoning power, than the habitations of ants or bees.

This volume is a striking example of the way in which the most confirmed invalids may employ and enjoy themselves; of the marvellous interest that attaches to the minute observation of the habits of many of the lower animals; and of the vast field for discovery that is still open to observers. It will long remain a standard work on the subject of which it treats, as well as a worthy memento of the enthusiastic and amiable naturalist whose early departure from among us will be so widely deplored.

A. R. W.

THE UNIONIDÆ

Observations on the genus Unio, together with descriptions of new species in the family Unionidæ. By Isaac Lea, LL.D. (Philadelphia, 4to.)

ALTHOUGH no date of publication is given, the last paper contained in this volume appears to have been read on the 3rd of February, 1874. It is a goodly volume of seventy-four pages, and twenty-two beautiful plates.

The number of this volume (xiii.) shows the extent to which the octogenarian, but still indefatigable author, Dr. Lea, has prosecuted his favourite study. He tells us in the Introduction: "In my twelfth volume I mentioned the number of North American species (Unionidæ) then known to be 772. By adding sixty to these, we have the number 832 species." And he remarks that "these do not by any means constitute the whole number of existing species; many of the smaller streams falling into our large rivers have not been explored, and these when well searched will unquestionably produce new forms of this numerous and interesting family."

Now it seems to us that the little word "forms" thus innocently used must disarm every conchologist of that weapon of criticism (species-making) with which Dr. Lea has been so often and so mercilessly assailed on this side of the Atlantic. Substitute "form" for "species," and what is there to prevent the European Unionidæ attaining a more respectable position as regards number than they do at present? In Great Britain we can show only five species, besides sixteen named and well-marked varieties. In Germany, according to Kreglinger, there are fifteen species (including some of our varieties), and twenty-nine named varieties. The number could be increased almost *ad infinitum* by reckoning every distinct form from each river, stream, lake, canal, and pond in which the Unionidæ are found; and we should lose one test of specific difference, which consists of ignoring all variation of shape caused by habitat, and which induces us to believe that undoubted species are those that live together without any intermingling or gradation. But whether all the North American Unionidæ are called "species," or "varieties," or "forms," Natural History and Conchology in particular are under a great obligation to Dr. Lea for his admirable works. One, perhaps not the least, merit is his symmetrical method of description, the characters of every species being given in the same relative order, so that they can be readily compared and the differences between the several species more easily ascertained. This is certainly important in his case; because some of the figures on the same plates bear a rather suspicious resemblance, *e.g.* those of *Unio globatus* and *subglobatus*, *U. tuscumbiensis* and *radiosus*, *U. crudus* and *pattinoides*, *U. yadkinensis* and *conasaugaensis*, *U. amplus* and *insolidus*, *U. rostellum* and *exacutus*, besides *U. subparallelus* and *basalis*. The above-named species are compared by the author, not with each other, but with different species.

Another reflection occurs to us on the perusal of this work; and that is as to the division of labour. A universal naturalist is now an extinct animal; and the region of biology becomes every day more and more subdivided into separate fields of investigation. Thus, in the Mollusca Mr. Davidson restricts himself to the Brachiopoda, Dr. Lea to the Unionidæ, and Dr. L. Pfeiffer to the Pulmonobranchia. Every other department of zoology, as well as of botany, has its own votaries for different orders and even families; and it is in this way that knowledge is at present advanced, not by some great Coryphæus, but by many less-gifted persons who have the opportunities and inclination

> "To labour and effect one thing specially."

OUR BOOK SHELF

La Vie; Physiologie Humaine, appliquée à l'hygiene et à la Médecine. Par le Dr. Gustave le Bon. (Paris: J. Rothschild, 1874.)

MOST authors compose their works first, leaving the preface until the last thing, in order that they may appreciate the full influence of their detailed study when making the generalisations with which they feel bound to start their volume. We have no reason to think that the author of the work under notice is any exception to this rule. In the nine hundred or so pages of his book he explains in a clear and very intelligible manner many of the most important facts and theories of the science of physiology; in some parts introducing improved methods of illustration, in others not quite recognising the most recent advances which have been made, even by his own countrymen. Particular stress is laid, throughout the work, on the bearing of the points discussed on everyday life, on hygiene, and on pathology; in all of which the author, from his experience in the routine of practice and the recent Franco-German war, in which he was engaged in active ambulance service, is able to speak with authority. There are two other points in which the work is slightly different from most text-books of the subject, one being that a short account is given of the history of most of the physiological discoveries of importance, which is generally neglected in works of similar character, notwithstanding the additional interest which is thereby introduced. The other point is, that an account is given of the anatomical construction of the organs whose functions are to be studied, by which means those who have not, as medical students, gained the necessary amount of knowledge of anatomy to make clear their fundamental notions, can read on and understand without reference to other works.

In the preface Dr. Le Bon enters into a short account of the aims and objects of the study of physiology. He remarks that "it is with profound wisdom that the philosophy of the ancients epitomised what ought to be known by man, in the maxim, printed in golden letters on the doors of their temples, *Know thyself*." We cannot, however, in any way agree with this physical distortion of the proverb, and think that the endeavour to place physiology on such a footing will never lead to successful results. The subject is not taught in schools, and it is true that the youth during several years of his life has, instead, been a student of the past, in company with the heroes of Greece and Rome. "The time has arrived for him to make use of his knowledge. He enters the business of life. He has to instruct the masses, lead the multitude; yet, of the nature of men, of their instincts, of their passions, he is absolutely ignorant." Notwithstanding all this, we must differ from our author in assuming that a thorough knowledge of the human organisation is indispensable, or even useful, in supplying the deficiency indicated; and there are many, we think, who will agree with us. No better proof that such is the case can be adduced than the medical profession itself. Its members are all more or less acquainted with the most important physiological facts and theories; supplemented, which is much to the point, with a thorough anatomical knowledge. Nevertheless, it is not to the medical profession that we are accustomed to look for moral philosophers, politicians, or novelists, but rather for thorough scientific workers, and an overwhelming percentage of nonentities, as far as the world at large is concerned. Statistics as to the average length of life amongst medical men would hardly show any advantage in their favour, and as patients they are notably unmanageable. As an education, physiology is therefore, no doubt, as good as any other science, but its further value is a delusion and a snare. It has been our object, on several occasions, to ascertain the amount of information as to the mechanism of the organ and of the piano possessed by some of the most accomplished musicians, and in nearly every case we have found that they are perfectly ignorant of acoustics and the mechanical construction of the machinery they are employing. And yet is not *Know thy instrument* at first sight as applicable to the musician as *Know thyself* to humanity at large? How few of us could pick to pieces and reconstruct a clock or watch, and yet how many of us have never missed a train in our lives!

These remarks are not made in disparagement of physiology, but in opposition to the misleading argument adopted by several others as well as the author of the work before us, to the injury of science itself in the estimation of the public at large, because of the false expectations it raises.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Fossil Remains of the Fallow Deer found in Malta

REFERRING to Dr. Jeitteles' monograph on the Distribution of the Fallow Deer, translated by Mr. Sclater (NATURE, vol. xi., p. 71), it may be interesting to record that fossil exuviæ referable to *Cervus dama* were discovered in Malta within the last few years. From inquiries I learn that they were found in a rock fissure impacted amongst the red soil which usually fills all the numerous rock rents of the island, where also fossil elephants' remains have been met with. The exuviæ in question were sent to the late Mr. W. Flower, F.G.S., and subsequently examined by Mr. Busk, Mr. Boyd Dawkins, and myself. They contain fragments of long bones and several entire feet bones and teeth, referable to small-sized adult individuals of the Fallow Deer. There is, besides, the molar of *Equus* and a canine referable to *Canis*, from the same situation.

The mineralogical aspects of the specimens are similar to those of the Quaternary fossil fauna of the island, but this is, as far as I can discern, the first instance of fossil remains of *Cervus* and *Equus* having been discovered in Malta or Gozo. Canine teeth of the same dimensions as the above, and referable to *Canis*, were found by Admiral Spratt and myself in conjunction with teeth and bones of *Hippopotamus pentlandi*, from the Malak Cavern of Malta.

Royal College of Science,
Dublin, Jan. 21

A. LEITH ADAMS

Electric Conductivity of Nerves

IN a recent number of NATURE (vol. x. p. 519) the reviewer of "The Protoplasmic Theory of Life" states broadly that few physiologists will agree with the statement in the book that the nerves are not better fitted for the conduction of electric currents than the other moist tissues, and that they possess no demonstrable apparatus for insulation of these currents. There must be some misunderstanding here, for I have adduced proofs from Dubois-Reymond, Ranke, Fick, and others, and I believe all physiologists of note concur in the view as represented by me. The reviewer has apparently overlooked the circumstance that one of the principal points in the chapter was the distinction of the conveyance by nerves of the *stimulus* caused by electricity, and the mere conduction of an electric current, for he says "there is not the least doubt that it is through the nerve-fibres that electric stimulation will most readily and most powerfully affect muscular fibres at a distance." No one, I imagine, does doubt this, but it is not at all the same thing as saying that the nerve is the best medium for affecting the muscle owing to its superior power of conducting electricity, for it may also mean that the nerve is susceptible to the stimulus of electricity. This is, indeed, sufficiently shown by the fact that a mechanical stimulation of the nerve will have a similar effect, while we do not attribute to the nerve any superior power of conducting mechanical force. Permit me to refer to the additional light thrown on the question in the recently published work of Prof. Vulpian ("Leçons sur d'Appareil Vaso-moteur," 1875). It had been asserted by Legros and Onimus, that on passing a galvanic current through a nerve containing vaso-motor filaments, the ascending current caused contraction, while the descending ones produced dilatation of the capillary arteries. The experiments of Vulpian and Carville yielded results not in accordance with this statement, and both currents were found to cause contraction. Vulpian explains this discrepancy by pointing out that Legros and Onimus assumed to act on particular nerves by sending the current through the skin and subjacent parts. "Not only," says Vulpian, "are we not authorised to believe that we act on these nerves by this mode, but, in addition, it is evident that we determine excitation of all the tissues comprehended in the current, the skin among others, and that that excitation may provoke reflex vascular dilatations which complicate the results" (p. 114). To perform the experiment properly, it is necessary to secure isolation artificially by cutting the channels of reflex vaso-motor action. Again, if you electrify the sciatic nerve in a dog which has been curarised, no contraction of the voluntary muscles to which it is distributed takes place. And in paralysis of the radial nerve in man from cold, the power of volition over the muscles supplied by it is lost, while the sensory and vaso-motor filaments bound up in the same nerve retain their functional activity. In those cases the power of conducting electricity is not impaired, nor is it indeed in the dead body even; but here, as expressed by Vulpian, "the musculo-motor filaments have lost their normal aptitude to cause the muscular bundles to pass from the state of repose to the state of activity" (p. 122). What that "normal aptitude" consists in is still a question, but it is certainly not the power of conducting electricity, although a knowledge of the latter is of great importance in judging of Dr. Beale's theory of muscular contraction.

Dr. Beale, as is well known, still holds to the opinion that the nerve-force is electricity, and that the nerves have not only the power of conducting electricity but of evolving it as a vital act on stimulation from the little masses of protoplasm, bioplasm, or living matter with which the nerve-cords are studded. Although there are many objections to this theory, still the badly-conducting power of the nerves for electricity does not appear an insuperable one when we think of the nerve-force merely as a stimulus, for the quantity of a stimulus necessary to rouse up vital action bears an infinitesimally small proportion to the result. But when the same force is assumed to be the efficient cause of muscular contraction, the question assumes a very different aspect. In Dr. Beale's theory the muscular fibre proper is held not to contain protoplasm, and to be incapable of living action or of evolving force, the contraction being produced by inductive electric action on the sarcous particles, which causes them to change their position and thus approximate the ends of the muscular fibre. The source of the electricity is said to be the protoplasm masses contained in the muscles, in continuous contact with the motor nerves, and it is conveyed to the muscular fibres by loops of fine nerve-fibres crossing them in various directions. In this theory, even supposing insulation to be complete, it is obvious that the conducting power of the nerve-fibre becomes of supreme importance, because not the stimulus only, but the whole force of muscular motion, must be conveyed by it. Now, the nerve-cords do conduct electricity certainly, but so many million times worse than metallic wires, that the loss of energy by transformation into heat must be enormous. Such a loss is inconsistent with the economy of nature and with the actual facts; therefore, unless the nerve-force is a specific force different from surface-electricity, galvanism, and magnetism, though analogous to them, and probably easily convertible into electricity, Dr. Beale's theory cannot be upheld. I have not yet seen any reply by Dr. Beale to this objection. JOHN DRYSDALE

Liverpool

Kirkes' Physiology

IN a letter headed "Kirkes' Physiology," in NATURE of last week, signed "W. Percy Ashe," your correspondent would not appear to be practically acquainted with the semi-lunar valves at the base of the great vessels emerging from the heart, for his arguments, although perfectly correct in themselves, and based on well-known physical laws, do not, I submit, apply in the instance he quotes, for the simple reason that the conditions necessary for their application do not exist.

Let us consider briefly the shape of the sinuses of Valsalva during the diastole of the ventricles of the heart. For our purpose we shall be sufficiently correct in describing them as three inverted, empty, and slightly truncated pyramids; one surface, the outer one, of each, is formed by the arterial coat, whilst the other two surfaces, constituting the semi-lunar valve, are in apposition with the corresponding surfaces of the other two valves. Now, the pressure over the whole surface of the sinus may be divided into four pressures, one sustained by each of the three sides, and one by the bottom.

The three sides sustain an equal pressure, but the two inner ones constituting the valve are by far the weakest, and the pressure on each of these is really supported by an equal pressure on the corresponding surfaces of the other two valves, and consequently may be considered as *nil;* whilst the pressure on the third side is resisted by its own strength, and it is formed, as I have said, by the wall of the artery, which is particularly strong at this point.

The remaining pressure is sustained by the bottom or truncated apex of the pyramidal pouch. This pressure is greater in proportion to its extent of surface than the other pressures—the column of fluid being higher—and this surface directly rests on and is *partially embedded* in the structure of the ventricle, which must thus undoubtedly support it.

Therefore the idea that "the reflux is most efficiently sustained by the muscular substance of the ventricle," which is the main part of Mr. Savory's theory, is most directly confirmed by the actual construction of the valves, and which your correspondent may see for himself by making a vertical section through the aortic valves in a sheep's heart.

As at the time of the greatest pressure on the valves the ventricles are dilating, it follows that they cannot reduce the area of the valves at that time, as your correspondent in his last remarks would seem to imagine, nor in fact can they ever do so.

4, Granville Place, Blackheath E. PRIDEAUX

The Rhinoceros in New Guinea

LIEUT. SIDNEY SMITH, late of H.M.S. *Basilisk*, reports that while engaged in surveying on the north coast of Papua, between Huon Bay and Cape Basilisk, being on shore with a party cutting firewood, he observed in the forest the "droppings" (excrement) of a rhinoceros in more than one place, the bushes in the neighbourhood being also broken and trampled as if by a large animal. The presence of so large an animal belonging to the Asiatic fauna in Papua is an important fact.

Skins of a very fine species of Bird of Paradise, having plumes of a brilliant red in place of the yellow plumes of the common species (*P. apoda*), were obtained from the natives further to the eastward. ALFRED O. WALKER

Chester, Jan. 21

[We should be inclined to doubt very seriously the occurrence of any rhinoceros in New Guinea. At any rate, the *important fact*, as our correspondent terms it, cannot be considered as established.

The red-plumed Paradise Bird of the south of New Guinea has been named by Mr. Sclater, *Paradisea raggiana* (P. Z. S., 1873, p. 559), from skins sent home by Mr. D'Albertis.—ED.]

Thomson's "Malacca"

IN your review (NATURE, vol. xi. p. 207) of Mr. J. Thomson's very interesting work on the "Straits of Malacca, Indo China, and China," you have justly acknowledged that the author "makes no pretension to have travelled in the interests of science, but only to be a photographer and an observer of the ways of men;" and as his excellent book will no doubt have a wide circulation, it may perhaps not be an unthankfu office to correct two statements with reference to the natura history of Penang, which I had some opportunity of studying during a sojourn there of some eighteen months.

Our author, describing the noise made by the insects on Penang Hill, says: "One beetle in particular, known to the natives as the 'trumpeter,' busies himself all day long in producing a booming noise with his wings." Had Mr. Thomson succeeded in observing one of these insects whilst "booming," which he states he was unable to do, I think he would have found the musician to have been no beetle at all, but one of the Cicadidæ, and the sound not produced by the wings, but, as i generally known, internally, by the vibration of a membrane se into action by a special muscle. These insects are abundant a Penang, one species, *Dundubia imperatoria*, being particularl large, and which, with several other species, were taken b myself when there. It is nothing unusual for these insects to b wrongly described by natives, as we are told by Mr. Gervase F Mathew, R.N. (in the *Entomologist's Monthly Magazine*), tha in Tobago *Cicada gigas* makes a noise like the whistle of a locomotive; and he was told by the natives that the sound was tha of the "tree-locust." At Surinam it is said *Cicada tibicen* i called the "harper," on account of its giving forth a sound lik that of a harp.

Mr. Thomson also tells us (p. 35), when describing plante life in Province Wellesley, that the planters, when driving hom at night from one estate to another, have the possibility of a encounter with an orang-outan, a rhinoceros, or a tiger. Th orang, however, is not found there at all, and I know of n instance of an attack by a rhinoceros. In fact, that animal i so scarce that during my whole stay there the only report of on which I heard was that the animal's dung had been seen in th jungle. Tigers are still anything but scarce, but during m many nightly rides whilst living on the sugar plantations I ar happy to say I never heard or saw one, nor was our roll-ca ever diminished by that animal. The tiger there is a midnigh prowler, but confines himself more to pigs, goats, and dog The wild animals are gradually being beaten back by the cult vation of the land, and the same may be said of even the insect No doubt they abound in the centre of the peninsula, and ther also, no doubt, may be found the Negrito stock, of which ou author has given us a good photograph as found at Johore.

The illustrations of this very interesting book are excellen and photography seems to be doing for anthropology wh spectrum analysis is still achieving for astronomy.

Streatham Cottage, West Dulwich W. L. DISTANT

Bees and Flowers

MY children noticed with much interest, last autumn, t curious manner that the bees attacked the flowers of the *Anti* *rhinum majus*, making a hole at the bottom of the corolla of the flower near the stalk, and so getting at the honey from the outside. It was too late in the season to be able to observe it much, or often, but we are pleased to find others have seen it too.

In Sir John Lubbock's lecture at the London Institution he said some "humble-bees sucked the honey of the French bean and scarlet-runner in the legitimate manner, while other bees cut a hole in the tube, and so reached it surreptitiously."

This flower I speak of is one with the corolla much more marked than those the lecturer quoted. Next season we will hope to watch it again, and see if it only happens late in the year, for the injured blossoms seemed to wither very soon after the incision was made. MARY J. PLARR

Tunbridge, Jan. 9

Iron Pyrites.—Curious Phenomenon

SOME iron pyrites exhibited in a particular case in the Maidstone Museum have crumbled into a coarse, finely-divided mass. The specimens have been exhibited for about two months, and the decomposition has been effected in that time. Some other specimens recently removed from another case are becoming soft.

Could any of your readers account for this, and has such a thing ever been observed before? FREDERIC CASE

Maidstone, Jan. 19

OUR ASTRONOMICAL COLUMN

ANTARES AS A DOUBLE STAR.—The small bluish companion of Antares was detected by Mitchel at the Observatory of Cincinnati in July 1845. Measures taken by him in the summer of 1846 are published in No. 4 of his *Sidereal Messenger*. They gave the distance 2″·52, the companion preceding on the parallel, at the epoch 1846·59, and Mitchel thought this distance was half a second greater than at the time he discovered the small star. He mentions that on the 13th of August, 1846, he saw the star distinctly at 5.30 P.M., "the sun shining, unobstructed by clouds or mist." Early in the year 1848, Antares was repeatedly measured by Bond with the great refractor of Harvard College, and by Dawes in this country.* Their mean result, weighted according to the number of nights, is—

1848·24 : Position ... 273°·71. Distance ... 3″·574.

The proper motion of the large star, though small, is still sufficiently sensible. Leverrier (*Annales*, tome ii.) assigns for the secular motion, -- 0s·059 in Right Ascension, and -- 3″·36 in Declination. If the above angle and distance are brought up to the present time with these values, we find on the assumption of merely optical proximity of the companion—

1875·25 : Position ... 288°·8. Distance ... 3″·54.

We would suggest that the star should be carefully re-measured, now that it is drawing away from the sun's place in the morning sky, to decide on the optical or physical connection of the components. Dawes' last measures in 1864 certainly rather favour the latter view, but they were made on a single night, and the object is one of difficult observation. It will be seen that on the assumption of optical duplicity, the distance is just now very nearly stationary, but the change of angle during the last twenty-five years amounts to 15 degrees, and will be easily confirmed or otherwise.

THE "TEMPORARY STARS" OF TYCHO BRAHE AND KEPLER.—The position of the famous star of 1572 in the constellation Cassiopea, with which Tycho's name is usually associated, has been determined with all the precision that his observations admit of, by Prof. Argelander, of Bonn. His place, reducing to the commencement of the present year, is in

Right Ascension	0h. 17m. 52s·6
North Declination	63° 27′ 18″.

Near to this position is a star of about the eleventh magnitude, which, by micrometrical comparison with two of its neighbours meridionally fixed, is found to have for the same epoch,

Right Ascension	0h. 17m. 52s·1.
North Declination	63° 26′ 24″.

It is, therefore, distant less than one minute of arc from the most reliable position of Tycho's star that can now be assigned. On this account alone it would be worthy of attention, but we are able to state, further, that during the last four years this small star has exhibited slight fluctuations of brightness at irregular intervals, which increases the probability of its identity with the star of 1572. It may also be noted that in August 1874 there was a decided ruddiness in its light.

Kepler's observations of the star which suddenly assumed such extraordinary brilliancy in the constellation Ophiuchus in the autumn of 1604, are contained in his work "De Stellâ novâ in pede Serpentarii," but the best position we possess is doubtless that deduced by Prof. Schönfeld of Manheim, from the observations of David Fabricius. For the commencement of the present year we have

Right Ascension	17h. 23m. 8s.·9
South Declination	21° 22′ 16″.

This position is probably liable to greater error than in the case of Tycho's star.

The nearest object at the present time is a star of the twelfth magnitude (or rather fainter), following the above place 6s·5 and 2½′ south of it, which has not sensibly varied during the last few years, but it is a suspicious circumstance that Chacornac has entered upon his chart No. 52, a tenth magnitude about 8s. preceding Schönfeld's place, and nearly on the parallel of declination, which is not now visible, or was not last summer. The neighbourhood requires to be closely watched. The observer may set the circles of his equatoreal for Oeltzen 16872, R.A. 17h. 23m. 34s., N.P.D. 111° 23′. The observations for Chacornac's chart were made between the 31st of May and 12th of August, 1861.

THE ZODIACAL LIGHT.—On the evening of Sunday last, the 24th inst., a surprisingly bright display of this as yet problematical phenomenon was exhibited. There was a repetition on the following evening, but in a less favourable sky. The light had the usual yellowish or pale lemon tinge of the more notable exhibitions in these latitudes. The axis of the light appeared to pass λ Piscium, and the vaguely-defined apex was situate somewhere about 19 Arietis, but it was not possible to locate it with anything like precision. The light was broad and of a deeper, perhaps, ruddy tint near the horizon. The display to which we have adverted, excelled in brightness any that has been witnessed in the neighbourhood of London for many years. It appears very probable that opportunities for favourable application of the spectroscope may be afforded in the dark evenings of the present and following months.

PLANETARY THEORIES *

THE theory of Neptune, which I have the honour of presenting to-day to the Academy, completes the *ensemble* of the fundamental theories of the planetary system, of which the first dates back to September 16, 1839, thirty-five years ago.

The numerous developments added year after year are all mentioned in the organ of the Academy. Some of them figure only by their titles, and as they are scattered through a great number of volumes, the Academy will no doubt permit me, at the moment when I have arrived at the end of this long discussion, to present a precise but succinct *résumé* of them.

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* "New Theory of the Motion of the Planet Neptune; with Remarks on the *ensemble* of the Theories of the eight principal Planets, Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, and Neptune" A paper read before the French Academy of Sciences by M. Leverrier, December 21, 1874.

In 1849, after I had already been engaged for ten years in the work, and the better able to estimate the difficulties, I presented its essential conditions in terms in which I have no alteration to make.

None of the tables, let us say, intended to represent the movements of the planets, accord rigorously with the observations. The most precise, those of the Earth and Mercury, are not so accurate as could be wished. I do not speak of those irregular discrepancies which the uncertainty inseparable from every physical measurement necessarily introduces between observation and calculation, but rather of those systematic errors whose variation follows a determined law, the real existence and regularity of which are prominent in the *ensemble* of the work of the different observatories, and for which theory alone can be blamed. These inaccuracies ought to engage our earnest attention; no doubt they are inconsiderable, but, on the other hand, they are everywhere present, and their smallness does not authorise us to neglect them.

It would assuredly not be very serious in itself that our astronomical tables should make an error of half a second in the time of the passage of a star on the meridian, if the importance of this error did not lie in its degree of certainty rather than in its magnitude. Every discrepancy betrays an unknown cause, and may become the source of a discovery. If these errors should increase considerably with the time, we may, it is true, await their complete development in order to read with greater certainty, in their onward progress, the cause which produces them; but, first, we should thus leave to posterity the task of perfecting science and the advantage of discovering new truths. Moreover, certain extraneous influences may manifest themselves by effects always slightly sensible; and if we neglect these effects, the cause on which they depend will remain for ever unknown.

The theory of the motion of a planet rests upon the hypothesis that each planet is subject only to the actions of the sun and of the other planets, and, moreover, that these actions are exercised conformably to the principles of universal gravitation.

But the consequences of the Newtonian law have not been, in many respects, deduced with sufficient rigour; and, on this account, we are not in a condition to decide if the disagreements evident between observation and calculation are due solely to analytical errors, or rather if they are partly due to the imperfection of our knowledge of celestial physics.

It will be necessary, then, to take up again the mechanical theories of the motions of the planets, and to rigidly examine them to their most remote consequences, before we are able to effect a decisive comparison with observations. This is what has been done.

Let us rapidly state that the general developments have been the subject of five memoirs, presented and published in 1840, 1843, 1849, and 1855.

The formulæ relative to secular irregularities have been treated particularly in the memoirs of 1840 and 1841.

The same subject has been handled, in a more general and more complete manner, in the paper communicated to the Academy on Nov. 11, 1872, concerning the four great planets, Jupiter, Saturn, Uranus, and Neptune.

The theory of Mercury, presented in 1843, since completely revised, was only definitely completed in 1859.

The theory of Venus was given in 1861.

That of the Sun (the Earth) in 1853 and 1858.

That of Mars in 1861.

The theory of Jupiter in 1872 and 1873.

That of Saturn in 1872 and 1873.

The theory of Uranus, given in 1846, and connected with the discovery of Neptune, was the subject of a new work presented on Nov. 15 last.

Finally, the last theory, that of Neptune, is offered by us to the Academy to-day.

The theories of Jupiter, Saturn, Uranus, and Neptune have the peculiarity that they are developed in functions of indeterminates, so that their use may be prolonged during an unlimited time.

The theories once established, it will be necessary to compare them with the long and valuable series of meridian observations devised by Rœmer, instituted for the first time at Greenwich, in September 1750, by the famous observer Bradley, and continued since then to our own days in the great observatories. But as the positions of the moving stars are connected with the fixed stars, it is evident that it will be necessary also to be assured of the relations of the stars among themselves, with respect to the equinox and the ecliptic. This necessity is particularly imposed in respect to right ascensions, on which specially depends a knowledge of the motions of the planets. The work was effected in the memoir of April 5, 1854, for the series of observations of Bradley. This was a delicate subject, for it necessitated the revision of the labours of Bessel, given in his work entitled "Fundamenta Astronomiæ." We have had to propose various corrections in the positions of the fundamental stars, and the verification of the accuracy of these corrections was put to the test (*au concours*) in Germany. The result confirmed all our determinations. Consequently they have served us in establishing with certainty the positions of the stars of comparison during the 120 years of observations which we have had to consider.

The comparison of the motions of Mercury with the theory given by us in 1843 did not present from the first a satisfactory result. The transits of Mercury across the Sun furnish data of very great precision, but which it was not possible completely to satisfy.

This first result fills us with uneasiness, it is known. May not some error in the theory have escaped our notice? New researches, in which everything was tested in various ways, only tend to convince us that the theory was accurate, but that it did not agree with the observations. Years passed, and it was only in 1859 that we managed to discover the cause of the established anomalies. We discovered that they are all connected with a very simple law, and that it is sufficient to increase the motion of the perihelion by 30½ seconds per century to reduce everything to order.

The displacement of the perihelion acquires thus in the planetary theories an exceptional importance. It is the surest indication, when it must be increased, of the existence of a cosmical matter yet unknown, and circulating like other bodies around the Sun. It matters not whether this matter may be agglomerated into a single mass, or disseminated in a multitude of meteorites independent of each other. Provided that its parts all circulate in the same direction, these effects combine to impress upon the perihelion a direct motion.

The consequence is clear. There exists in the neighbourhood of Mercury, between the planet and the Sun, without doubt, a matter, a material hitherto unknown. Does it consist of one or more small planets, or of meteorites, or even of cosmical dust? The theory does not pronounce on this point. On many occasions, trustworthy observers have declared that they observed signs of the passage of a small planet across the Sun; but nothing definite has been reached on this subject.

We should not, however, doubt the accuracy of the conclusion. We shall see, in fact, the same analysis applied to the discussion of the observations of Mars lead to an analogous result, and this result found fully verified.

Bessel has said of the theory of the sun that it has not made the progress we should have expected from the great number and the value of the observations. This estimate has for long troubled our mind, too trustful of this supposed accuracy of the observations. After having revised and discussed anew the observations of the Sun, made since the time of Bradley at Greenwich, at Paris, at Königsberg, to the number of 9,000, we have been forced to quite a different conclusion, viz., that the observations of the Sun are far from what they ought to be, on account of the systematic errors which affect them, and that there is no discordance between theory and observation which may not be attributed to errors in the latter.

In spite of all, the discussion of the observations of the Sun led us hence to an important result connected with the great question which agitates, at this moment, the scientific world; a result which surprised ourselves, so much had the determination of the parallax of the Sun, deduced by the director of the Berlin Observatory from the Transits of Venus in 1761 and 1769, inspired a false confidence. I arrived at the conclusion that the parallax of the Sun, estimated then at 8·57″, ought to be increased by the 25th part of its value.

Soon after, the comparison of the theory of Venus with the observations led to the same result, the necessity of increasing by $\frac{1}{26}$ the parallax of the Sun.

Finally, the theory of Mars led, in its turn, to a conclusion not less precise. It was proved that we could not account for the *ensemble* of the observations of Mars without increasing the movement of the perihelion by about one-eighth. This was the reproduction of the same fact as in the case of Mercury, and the conclusion to be drawn from it was the same, viz., that the planet Mars must be subject to the action of a quantity of matter till then neglected, and that it must be estimated at the eighth part of the mass of the Earth.

But then two hypotheses were possible, as we explained at the *séance* of June 3, 1861: either that the matter till then left out of the count resided in the belt of the small planets as a whole, or that it must be added to the Earth itself. In the latter case, and as a consequence, the parallax of the Sun must be increased by the 24th part of its received value, that is to say, that we would be led to the same result already deduced from the theories of the Sun and of Venus.

Meantime M. Fizeau has given a method for determining the speed of light, by a physical experiment, on the surface of the earth; and from this measurement, combined with the quantity of the aberration of the stars, we know that we can deduce the parallax of the Sun.

Foucault, on his part, had devised a plan of solving the same question by another method, and he was engaged in realising the experiment. I pressed him strongly to carry it into execution. We know that in the *séance* of Sept. 22, 1862, Foucault announced that he had fixed the rate of light at 298,000 kilometres per second; hence, by adopting the quantity of aberration determined by Struve, 8·86″ resulted for the parallax of the Sun, a number corresponding to an increase of 1-30th of the received value.

M. Cornu, in the important paper read by him at the last sitting, resolved definitively the question by the employment of the method of M. Fizeau. He was good enough to refer to the determination which I presented to the Academy at the sitting of July 22, 1872, based on the celebrated and very exact observation of the occultation of the star ψ^2 Aquarii by the planet Mars, an occultation observed in 1672 by the three great astronomers, Richer, Picard, and Rœmer.

Moreover, we shall combine materials obtained from various points of view on this delicate question, and will further increase by discussion the great interest which will be presented by the materials collected with so much devotion by the various expeditions destined to the observation of the present Transit of Venus. For this reason, and because the method which results from the occultation of ψ^2 Aquarii is present under a form precise and striking, we shall shortly ask permission from the Academy to deposit the work in its hands, after having given it the necessary developments.

Jupiter and Saturn have given rise to a theoretic work the extent of which has been considerable, on account of the very great mutual perturbations of the two planets. The comparison of the theory of Jupiter with the observations has presented, after the proper modifications of the elements, a complete harmony. The tables of Jupiter have also been adopted by the editor of the *Nautical Almanac* to serve for the preparation of that important work. I owe to our *confrère* Mr. Hind, superintendent of the *Nautical Almanac*, the satisfaction of thus seeing adopted by the astronomical world the various tables of Mercury, the Sun, Venus, Mars, and Jupiter, so far as they have appeared.

The tables of Saturn are now constructed, and their comparison with the observations is almost finished.

The theories of Uranus and of Neptune being also completed, it only remains further to effect their comparison with the observations.

The profound knowledge which my excellent colleague M. Gaillot, chief of the Bureau des Calculs, and member of the Council of the Observatory, has of these matters, and the devotion with which he has assured the laborious construction and comparison of the tables of Jupiter and Saturn, are to me a sure guarantee that the final work will be, whatever happens, carried out to the end.

RUSSIAN FORESTS

VEGETATION in the fossil or recent state forms the main source of the wealth and prosperity of most nations, either directly or indirectly: directly, in the case of the vast subterranean deposits of the remains of former plant-life in Britain, as also in the broad expanses of land covered with timber-trees in Russia. According to recent statistics* the extent of the forests of Russia in Europe is about 442,897,500 acres, or forty per cent. of the whole area. The forests are very unequally distributed, and internal communication is still very imperfect in many parts of the empire; hence much of this wealth is at present unavailable. Every year, however, the facilities for transport are increased, and there is a corresponding augmentation in the amount realised. Nearly sixty-five per cent. of the forest land is situate in the four governments of the North—Archangel, Vologda, Olonetz, and Perm; this equals sixty-five acres to each inhabitant. The governments of the South are relatively poor in timber, and in some parts almost treeless; but since 1842 the forest administration has been engaged in remedying this defect by planting largely. Between 1866 and 1870 upwards of 20,000 acres were planted, exclusive of the action of private owners. The principal trees are the Scotch pine, spruce fir, larch, birch, lime, aspen, and oak. To these may be added for the governments of the South, though relatively playing an unimportant part in commerce, the elm, ash, beech, hornbeam, maple, various poplars and willows, &c. The value of the forest products exported in 1871 amounted to 16,026,553 roubles, of which more than one-third came to this country. But the internal consumption gives a better idea of the immense wealth of these forests. It is only possible to give an approximate estimate of the value, which Mr. Werekha states must be at the very least 265,450,000 roubles per annum. In Russia, wood is still either the only or the principal fuel used. The railways consume wood for fuel to the annual value of 7,200,000 roubles. Wooden drinking-vessels, platters and spoons, take the place of pottery and metal in many districts, except in the houses of the rich. Mr. Werekha estimates that forty million wooden spoons are made every year; but Mr. Weschniakoff, in his account of the domestic industries of Russia, puts the figure at thirty millions.

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* "Notice sur les Forêts et leurs Produits," etc. Par P. N. Werekha.

11325 29.10.76

But the most destructive industry, so far as the forests are concerned, is the manufacture of bast mats, bark boots (*lapti*), cordage, and other articles prepared from the liber or inner bark of the lime, birch, and willow, chiefly of the former tree. It is computed that 100,000,000 pairs of *lapti* are made annually, each pair requiring the bark of four young trees; thus 400,000,000 trees are cut down every year for shoes! Lime-trees from five to ten years of age, and half-grown birch, are employed for this purpose. Such reckless waste is much to be regretted; and Mr. Werekha observes that the pines are tapped for their resin and bled to death in from ten to fifteen years, in the same way as the Landes of Gascony were denuded of their pine-forests during the last century.

The previously almost useless aspen, either for fuel or building, has attained to considerable importance within the last few years as a material for paper-making. There are already ten manufactories actively engaged in the preparation of this paper in Russia, and two in Finland; and as vast reserves of this tree have accumulated in the forests, it is expected to prove a source of great riches for many years to come. Timber, of course, is the most valuable article exported, though resinous products and bast mats bring in a large sum. The Scotch pine, spruce fir, birch (for coach-building), and the oak, are the principal and almost the only timbers exported. Speaking of the giant oaks of Russia, Mr. Werekha becomes almost sentimental, for they form the strength of British and French shipbuilders, and occasionally revisit their native country in a form by no means flattering to national pride, as the Russians are still very small shipbuilders.

THE INDIA MUSEUM*

THE India Museum, at present located at Whitehall, has long been known for its extensive and valuable collections of Indian products, a collection too valuable, indeed, not to have been made more available, both for scientific and commercial purposes, than it has been. The removal, however, of the specimens to the galleries at South Kensington will bring them within the reach of ordinary mortals who have neither bodily strength nor inclination to make a pilgrimage to the topmost floor of one of the highest buildings in London.

The importance and value of these collections has to some extent been shown in the several reports which have from time to time been issued from the Foreign Office. Dr. Forbes Watson, as Reporter on the Products of India, has done much service in this respect, and Dr. M. C. Cooke, who has drawn up the present report, is no novice amongst Indian gums and resins, having gained an extensive experience from his long official connection with the Museum.

There are, no doubt, many products of the Indian forests that ought to be included in European commerce, but, from the want of a proper knowledge of their uses, have never established themselves in the market. Individually, we have often deplored the prevailing prejudice amongst commercial men in favour of old and well-known commodities, amounting sometimes even to the absolute rejection of new products, without giving such products a fair trial. Dr. Forbes Watson, in an introductory note to the report under consideration, in reference to this, says it should "be remembered that gums or resins sent over for valuation in the London market are necessarily subject to comparison and competition with the very best qualities of the same substances which come into any of the European markets, and that careful collection is not a too frequent characteristic of Indian products." Dr. Watson further points out that it is of very great importance to the existing and future trade of India that samples should be sent home in sufficient quantity for report, since this is the only means by which they can be brought under the notice of competent authorities. For this purpose it is suggested that in the case of gums, resins, &c., quantities of from 20 lbs. to 25 lbs. would be sufficient for distribution amongst brokers and traders, as well as for analysis and experiments. The necessity, also, of obtaining accurate information on the botanical source of the plant yielding any particular product is strongly urged. The value of accurate specimens gathered at the time of collecting the article itself, whether it be gum, resin, wood, or fibre, must be apparent to everyone, and is strongly advocated in the article "Botany" in the "Admiralty Manual." In all cases such specimens should consist of leaves, flowers, and, where possible, fruits also, securely labelled and numbered, so that no mistake may occur.

This report of Dr. Cooke's is valuable, as it brings together nearly all that has been written on the gums and resinous products of India. The botanical synonymy of each species, with references, is first given; next, a short botanical description; then its habitat, native names, history, description, and uses; and finally, in the case of the most important products, references to the works where the subject has been treated of. Dr. Cooke has brought his report down to the most recent period, for we find under the genus Garcinia, of which the species are described as yielding gum, a description of *G. Griffithii*, with the following note:—"Anderson says of this plant that there is in Maingay's herbarium a plant very like it in habit, but described by him as having a circumsciss anther, which is cultivated in Singapore as the true gamboge of Siam. There still appears to be some doubt as to the source of Siam gamboge, which Dr. Hooker seems disposed to attribute to this tree." The fact is, that in the most recent revision of the order, *Garcinia Griffithii* of Anderson has been considered identical with *G. morella*, var. *pedicellata*, to which Siam gamboge has been referred by Hanbury, and which Dr. Hooker thinks has sufficiently distinctive characters to raise it to the rank of a species under the name of *G. Hanburyi*. Again, Dr. Cooke refers to the very recent work of Flückiger and Hanbury, in which Siam gamboge is attributed to *G. morella*, var. *pedicellata*, as stated above. Indeed, throughout the report there are frequent references to the "Pharmacographia," but we are not a little surprised that Stewart and Brandis's "Forest Flora" is not quoted. Thus, for instance, at p. 24 of the report, the Marking Nut, *Semecarpus anacardium*, is dismissed with very few lines; while in the "Forest Flora" is an excellent description of the tree; of the wood, which "is full of an acrid juice which causes swelling and irritation, so that the timber cutters object to fell it unless it has been ringed for some time;" and of the fruit and the black varnish, which is prepared from the pericarp, and which is used mixed with lime-water for marking cotton. Small consignments of these fruits occasionally arrive in this country, and not long since a quantity of a very fine kind came into the hands of a London house.

J. R. J.

UMBELLULA, OR CLUSTER POLYP

ABOUT six months since (vol. x. p. 142) we referred to a letter from Prof. Wyville Thomson, in which he mentions having brought up from a depth of nearly 1,500 feet, between Prince Edward's Island and the Crozets (Kerguelen's Land), specimens of an Umbellula. When the *Challenger* was between the coasts of Portugal and Madeira, several specimens of another species of the same rare genus, but from a depth of about 2,000 feet, were also dredged up. The history of these curious Cluster Polyps is interesting. Some hundred and twenty years ago, and some one and twenty years before M. Kerguelen discovered the land now bearing his name,

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* Report by Dr. M. C. Cooke, on the Gums, Resins, Oleo-resins, and resinous products in the India Museum, or produced in India. Prepared under the direction of the Reporter on the Products of India. 1874.

Capt. Adriaanz, the master of the whaling-ship *Britannia*, being then in lat. 79° N., and about eighty miles from Greenland, on pulling up his sounding line, found two specimens of a large plant-like polyp clinging to it; the length of the stem of the larger specimen was six feet, and he noted that the expanded flower-like polyp which was at one end of the stem was of a fine bright yellow colour. Struck by their size and beauty, and the strangeness of such creatures living at a depth in the sea of more than 220 fathoms, he brought them home to his friend Mr. Dunze, of Bremen, who had been a pupil of the illustrious Haller. Mr. Dunze gave the smaller specimen to Christlob Mylius, a Professor of Botany at Leipzig, and the larger to Peter Collinson, F.R.S.; this latter gentleman gave it to John Ellis, of zoophyte fame, to describe, which he did in the Philosophical Transactions for 1752, accompanying his description with a plate. What became of this specimen is unknown. Mylius's one found its way into a collection in Göttingen, and was not to be found there by Pallas in 1766. No specimens being found for thus more than a century, an air of uncertainty hung round this Cluster Polyp, and its portrait, so often copied in our text-books, seemed to be all one was likely to know about it. It was, therefore, with the greatest delight that the writer of these lines, in the summer of 1872, saw two specimens of Umbellula in the Swedish Museum of Natural History at Stockholm; one rare object after another had been shown to him by Prof. Lovén; but the Umbellula, though the last, was not the least of the treasures accumulated therein by this esteemed professor, who stated that Mr. J. Lindahl had dredged them up during the expedition of H.S.M. *Ingegerd* and *Gladan* to the Greenland Seas in 1871. Within the last few days we have received from Stockholm a quarto memoir, "Om Pennatulid-slägtet Umbellula af Josua Lindahl," with three plates. This memoir was read before the Royal Swedish Academy in February 1874, and describes the two specimens as two species, under the names of *U. miniacea* and *U. pallida*. Prof. Kolliker has also described one of the species found during the *Challenger* expedition as *U. Thomsoni*, making four species of the genus now described. It is marvellous what changes have taken place in our knowledge of the Natural Sciences in the interval between the description of Ellis's species and those so excellently described and figured in the memoir before us. The other genus Grinillum of the family Umbellulinæ, found about 1858 in a depth of 2,700 fathoms in the Banka Sea, will, we trust, be re-discovered by Prof. Wyville Thomson. It is only known by a fragment of the stem in the Leyden Museum, the crown of polyps having fallen overboard as Capt. Siedenburg, after whom the species is called, was pulling in the line to which it clung.

E. P. W.

SCIENCE IN THE ARGENTINE REPUBLIC[*]

THE Bulletin of the National Academy of Exact Sciences of Cordova, of which the three first numbers have lately reached this country, gives us an interesting account of a new endeavour of the well-known naturalist, Dr. Burmeister, to introduce scientific studies into his adopted country. In 1868 Dr. Burmeister presented a memorandum to Dr. Sarmiento, lately President of the Argentine Republic, upon the expediency of adding a Faculty of Mathematical and Physical Sciences to the National University of San Carlos in Cordova. In response to this appeal authority was given to Dr. Burmeister by the Minister of Public Instruction to import eight professors from Germany to establish the Faculty; and Dr. Burmeister himself was appointed Special Commissioner for the purpose, and eventually Director of this branch of the University. For a long time, Dr. Burmeister tells us, his exertions to obtain a staff of professors from his old colleagues in Halle were unsuccessful. The novelty of the idea and the distance of Buenos Ayres rather stood in the way of his offers being accepted. At length, in 1870, two of the vacant posts were filled by the arrival of Dr. Max Siewert to occupy the chair of Chemistry, and of Dr. P. G. Lorrentz to fill that of Botany. In the following year the assistance of Dr. G. H. Weyenbergh, of Haarlem, was obtained for the chair of Zoology, and that of Dr. Sellack for the professorship of Medicine. Not until 1873 was the staff finally completed by the appointment of Dr. Vogler to the professorship of Mathematics. In the same year, as we understand from Dr. Burmeister's report, the plans for the construction of the new buildings necessary for the University were finally approved of by the National Congress, and the works are now in process of execution.

From notices which subsequently appear in the *Bulletin* we fear that Dr. Burmeister has met with some difficulties in controlling his staff of professors. This can be hardly wondered at when the novelty of the plan is considered, and the difficulty of getting eight persons, strangers to each other, to work together to establish a new institution in a far distant country, where a foreign tongue is spoken. We have little doubt, however, that under Dr. Burmeister's supervision all will ultimately right itself, and that the Academy of Exact Sciences of Cordova will become an institution highly creditable to the enlightened rulers of the Argentine Republic, who have established the National Observatory under the direction of the distinguished astronomer Dr. Gould in the same city.

That some progress has already been made in the cultivation of the natural sciences in Cordova is apparent by several papers contributed to the first three numbers of the *Bulletin*, amongst which are essays "On the Land and Fresh-water Molluscs," by Dr. Doering; "On certain genera of Microlepidoptera," by Dr. Berg; "On the Vegetation of the province of Tucuman," by Dr. Hieronymus; and "On the Salinas of Buenos Ayres," by Dr. Schicken-dautz.

NOTES

At the suggestion of the Council of the Royal Geographical Society, a manual will be prepared for the use of the Arctic Expedition, consisting of reprints of papers in the transactions of learned societies which would not otherwise be accessible, and other materials; the object being to furnish an exact view of the state of existing knowledge of Greenland and the surrounding seas. The geographical and ethnological portions will be undertaken by the Arctic Committee of the Geographical Society. The other sections will be edited by Mr. Rupert Jones, under the supervision of a Committee of the Royal Society. The appointments of the lieutenants and other officers to the Arctic Expedition were made this week. The Royal Society has recommended the appointment of a botanist and a zoologist for the consideration of the Admiralty, but they have not yet been officially selected. Good progress is being made in the strengthening of the ships at Portsmouth, which have been ordered to be ready for sea by the middle of May. The statement, in some of our contemporaries, that Capt. E. Hobart Seymour is to be second in command of the Expedition, is incorrect.

MANY sorts and conditions of men will regret as a personal loss the death of the Rev. Charles Kingsley, which took place on Saturday last. We regret his loss as that of a man who had a warm love for science, and who by his writings and example has done much to foster a love for it among others. He was an honour to his country and his cloth, and it would be a good thing for the latter in many ways if its members could be persuaded to follow his example, and, like him, take a hearty interest in every healthy form of human activity. Few men have been more loved than Charles Kingsley, and the wide influence of his example and teaching has been undoubtedly for good.

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[*] Boletin de la Academia Nacional di Ciencias Exactas existentente en la Universidad de Cordova. Entregas 1, 2, and 3. Buenos Aires, 1874.

THE death is announced of M. d'Omalius d'Halloy, the well-known veteran Belgian geologist, as having taken place on the 15th inst., at the age of ninety-two years. M. d'Halloy was born at Liége on February 16, 1783. He was a member of the Royal Academy of Brussels, of which he was president in 1850, Corresponding Member of the French Academy of Science, and Member of the Geological Society of Paris. He was author of a large number of scientific works; among others, "Eléments de Géologie" (1831), "Introduction à la Géologie" (1833), "Précis élémentaire de Géologie" (1843), "Abrégé de Géologie" (1853), besides numerous memoirs in the *Journal des Mines*, the *Journal de Physique*, the *Annales des Mines*, the *Mémoires* of the French Geological Society, and the *Bulletin* of the Belgian Academy.

WITH regard to the Transit of Venus, the following telegram, dated Aden, Jan. 21, has been received:—"Ingress and egress well observed from three stations in Rodrigues; nine Janssen plates; fifty-eight sun-pictures. Observers, Neate, Hoggan, Wharton."

A GENTLEMAN whose name is unknown has made a gift of 10,000*l*. for the promotion of university education among the working classes of Nottingham.

AT the recent meeting of Convocation of the University of London, a resolution was unanimously carried, "That in the opinion of Convocation it is desirable that a special examination be instituted in this University in the subjects which relate to public health." It was stated that there is every probability of the Senate giving force to the resolution by the establishment of an examination of the character indicated.

A COURSE of six lectures on scientific subjects, in the Town Hall, Stratford, was commenced on Monday by Mr. J. Norman Lockyer, F.R.S., whose subject was the "General Principles of Spectrum Analysis." The hall, we believe, was crowded with an attentive and intelligent audience, largely composed, apparently, of people belonging to the working classes. Mr. Lockyer lectures on the same subject next Monday, and on the two succeeding Mondays Dr. Martin Duncan, F.R.S., lectures on "Mountain-making" and on "Coral Islands." On Mondays, March 1 and 8, Dr. Carpenter, F.R.S., will lecture on "Deep-sea Researches." The lectures are given in connection with the Gilchrist Educational Trust.

THE Council of the Royal Horticultural Society have recently instituted a series of fortnightly lectures on Wednesday evenings, at eight o'clock, intended especially for those Fellows and their friends whose engagements prevent their attendance at the Wednesday afternoon meetings, and for the instruction of their gardeners. The first lecture of the series was delivered by Prof. Dyer, on the Growth of Ferns from Spores, which was followed by one last evening by Mr. A. W. Bennett, on the Fertilisation of Flowers by means of Insects.

FEW papers of greater interest to botanical students have recently issued from the press than Mr. Bentham's treatise on the recent progress of systematic botany, read at the Belfast meeting of the British Association, and which, but for untoward circumstances, would have formed the address to the Linnean Society at the Anniversary Meeting in May last. Commencing with a review of the history of systematic botany from the time of Linnæus, and of the gradual introduction of the natural system, he then considers the principal works in this branch of science recently published, or now in progress, under the following heads:—(1) *Ordines Plantarum*, or general expositions of the orders and sub-orders constituting the vegetable kingdom; (2) *Genera Plantarum*, or systematic descriptions of all the genera constituting the vegetable kingdom; (3) *Species Plantarum*, or systematic enumeration and descriptions of all known species; (4) Monographs of orders and genera; (5) Floras, or histories of the plants of particular countries or districts; and (6) Specific descriptions, detailed or miscellaneous. The practical advice of this veteran systematist to compilers of works of this description should be carefully studied by all botanical writers.

A NEW French weekly scientific periodical has issued its first number under the patronage of a Standing Committee of the French Geographical Society. It is edited by M. Herz, one of the staff of the *Journal Officiel*. It is called the *Explorateur*, and is published for the purpose of promoting the cause of geographical exploration among the French. One of its first objects is to send trustworthy travellers into the Sahara, where M. Dourneau-Dupré and others were murdered a few months ago. The *Explorateur* is opening, at present, a private subscription on behalf of M. Largeau, who is desirous of trying his chances in the same region. Some native pioneers have been also sent out, and are expected shortly to transmit valuable intelligence from the central Sahara.

A PARCEL of dried plants has recently been received at Kew from the Samoan Islands, sent by the Rev. Mr. Powell. Some novelties may be expected from this region, as it is still very little explored.

PROF. DYER'S article on the Tree Aloes of South Africa, recently published in this journal, having elicited numerous inquiries respecting this curious genus, it may be interesting to some of our readers to know that several fine species are in flower at the present time in the Succulent House at Kew.

TREE FERNS are nearly all of elegant and pleasing habit, and one deserving these epithets in a high degree is *Cyathea insignis*, a native of Jamaica and other West Indian islands. A magnificent specimen of this species recently attracted admiration in the tropical conservatory at Kew. It has fronds upwards of twelve feet in length, the stipes or stalks of which are densely clothed with long glossy scales.

ABOUT fifty new genera were added to the flora of Australia during the year ending with the appearance of Baron Mueller's last report, many of them of great interest in phytogeography. The following are a few of the more interesting:—Corynocarpus, Carmichælia, Ilex, Lagerstrœmia, Agrimonia, Embothrium (§ Oreocallis), Ulmus (§ Microptelea), Moræa, Areca, and Wolffia.

PASSING through the greenhouse containing the collection of succulent plants at Kew the other day, a correspondent was much struck with the flowers of a plant he had previously taken to be an ivy. The resemblance in foliage and habit is indeed so strong that a botanist might easily mistake it for a species of that genus, unless, of course, it was minutely examined. It is a native of South Africa, and is referred to the familiar genus Senecio, *S. macroglossus* being its name. The yellow flower-heads are large and showy, the ray-florets being few and broad. A figure of it, we are informed, will shortly be published in the *Botanical Magazine*. This plant has been introduced into St. Helena, where it bears the name of Ground Ivy, as may be learned from the label attached to a specimen in the Kew Herbarium, sent from thence by Mr. Melliss. Several other South African species of the same genus present equally interesting peculiarities.

BOXWOOD, the wood of *Buxus sempervirens*, which is almost exclusively used for the best kinds of wood-engraving, has been for some years becoming more and more scarce. Wood of the largest diameter is the produce of the forests of the countries bordering on the Black Sea. Large quantities are produced in the neighbourhood of Poti, from which port the wood is shipped direct to England. The supply, however, from this port is, we learn, becoming fast exhausted; and it is said, unless the forests of Abkhassia are opened to the trade, it must soon cease altogether. The quantity exported from Poti during the year 1873 amounted to 2,897 tons, of the value of 20,621*l.*; besides this, from 5,000 to 7,000 tons of the finest quality annually pass through Constantinople, being brought from Southern Russia and from some of the Turkish ports of the Black Sea for shipment, chiefly to Liverpool. An inferior and smaller kind of wood supplied from the neighbourhood of Samsoon is also shipped at Constantinople to the extent of about 1,500 tons annually. With regard to the boxwood forests of Turkey, the British Consul at Constantinople reports that they are nearly exhausted and that very little really good wood can now be obtained from them; in Russia, however, where some little Government care has been bestowed upon forestry, a considerable quantity of choice wood still exists; but even there it can only be obtained at an ever-increasing cost, as the forests near the sea have been denuded of their best trees. The trade is now entirely in English hands, although formerly Greek merchants exclusively exported the wood. In the province of Trebizonde the wood is generally of an inferior quality; nevertheless, from 25,000 to 30,000 cwts. are annually shipped, chiefly to the United Kingdom.

THE trade between Portugal and Great Britain is very largely composed of fruits of the Citrus tribe: the value of the exports from Portugal have, however, of late been considerably augmented, and will be more so in a few years, by the large number of pine-apples shipped to England. During the last two or three years the cultivation of this fruit in the Azores for export purposes has been largely developed. Bananas, also, have occupied much attention, and have been exported in such quantities, and realised such remunerative prices, that a large and flourishing trade may be expected. With these products already established and yielding satisfactory returns, it would scarcely be supposed that landowners would devote their attention to other and untried crops; yet we learn that the *Phormium tenax*, or New Zealand flax plant, has been introduced into some parts of the Azores, where its growth has proved highly satisfactory; and as it is proved that it will flourish in places where nothing else will grow, it may, in course of time, become an article of export.

THE distillation and manufacture of attar of rose is a large and important branch of industry in Adrianople. In the northern parts of the country, we are told in an official document, the produce of 1873 exceeded by 35 per cent. that of the previous year, the quantity distilled being some 121,875 ounces, valued at about 90,000*l.* It is chiefly exported from Philipopoli to England, France, Germany, and Austria; and recently merchants in the United States and Germany have opened correspondence with firms in Adrianople, with the view of establishing agencies to further extend this branch of commerce.

A VALUABLE and interesting report reaches us from New Zealand, on the "Durability of New Zealand Timbers." It has been drawn up by Mr. T. Kirk, F.L.S., and is by far the best account of the woods of that colony that we are acquainted with. New Zealand has exhibited her timbers at several of the international exhibitions; and though many of them have been remarkable both for size and beauty, they have never rivalled those of our Australian colonies, owing to want of care in seasoning, preparing, and naming the specimens. In some practical hints on seasoning timber, Mr. Kirk rightly says that no plan is so effective as keeping it in well-ventilated sheds, protected from the rain. He points out errors in felling and using timber, which all practical foresters and builders are acquainted with, but which are unfortunately of too frequent occurrence in many countries, namely, felling trees during the growing season, using timber immediately after felling, coating green or unseasoned wood with paint, &c. In the list of useful woods given, which number thirty-eight distinct trees, the Kauri (*Dammara australis*), Totara (*Podocarpus totara*), and the Red Pine, or Rimu (*Dacrydium cupressinum*) have a first place. The first-named is the finest tree in New Zealand, growing to a height of 120 to 160 feet; its wood, also, is the most valuable, being used before all others for masts, spars, and other shipbuilding purposes. The wood is frequently very beautifully mottled, and would be much valued by cabinet-makers in this country, were it an article of import; but New Zealand woods reach us only occasionally. The Kauri is largely used in New Zealand for railway sleepers. As an instance of its durability, Mr. Kirk says that near Papakura, an ancient Kauri forest has been buried at some remote period; in some places the logs still show above the surface. Much of the timber has been dug up in perfectly sound condition, and used for sleepers on the Auckland and Waikato Railway. Kauri timber is also exported to some extent from New Zealand to Australia, Tasmania, and Mauritius; and during the past three years the quantity so exported has more than doubled. Considering the limited area to which the tree is confined, it is to be hoped that some system of conservancy will preserve the trees.

THE Senatus of Edinburgh University has received a favourable reply from the Treasury as to an endowment for the proposed Chair of Education. Dr. Bell's trustees offered an endowment of 4,000*l.*, and the Senatus asked Government to grant a similar sum to complete the endowment. It is also stated that the arrangements for the establishment of the Chair of Education in the University of St. Andrew's are in such a state of forwardness that it is expected they will be completed forthwith, and that a Professor, with a suitable endowment, will be ready to enter on his duties by the beginning of next winter session.

THE Council of the Society of Arts have decided to offer the Society's Fothergill Gold Medal for an effective means of extinguishing fire on board ship, and they have directed the Secretary to enter into communication with leading shipowners, with the view of enlisting their aid in this important matter.

AN underground railway was inaugurated between Pera and Galata a few days since.

THE meeting at Paris of the International Conference on the Metrical System has been postponed till March 1.

ON the morning of January 22 an earthquake was felt at Ravenna, in Central Italy. The exact hour is not stated. It would be curious to ascertain whether it was connected with the rapid elevation of barometric pressure of 17 millimetres in a few hours, which was observed at the Paris Observatory and in many other places in France at the same time.

AT a recent meeting of the Academy of Natural Sciences of Philadelphia, Prof. Leidy—from a study of some fresh specimens sent him by Prof. Hayden, and obtained about one hundred miles east of Greeley, Colorado—declared his conviction that the colossal genus *Brontotherium* of Marsh is synonymous with *Symborodon* and *Miobasileus* of Cope; and that all these must give place to *Titanotherium* of Leidy, of which there are probably not more than two species.

MR. S. W. GARMAN describes, in the Proceedings of the Boston Society of Natural History, a new American species of serpent from Florida, under the name of *Helicops alleni*.

MR. WILCOX communicates to the Academy of Natural Sciences of Philadelphia the account of an unusual mode of burial which was formerly practised among the Indians of North Carolina. He states that in numerous instances burial-places have been discovered where the bodies had been laid with the face up and covered with a coating of plastic clay about an inch thick. A pile of wood was then placed on top and fired, consuming the body and baking the clay, which retained the impression of the body. This was then lightly covered with earth.

INTERESTING additions to our knowledge of the fauna of the Mammoth Cave have recently been made by Mr. F. W. Putnam, of Salem, U.S., who, as a special assistant on the Kentucky State Geological Survey, of which Prof. N. S. Shaler is the director, had great facilities extended by the proprietors of the cave, and he made a most thorough examination of its fauna, especially in relation to the aquatic animals. Mr. Putnam passed ten days in the cave, and by various contrivances succeeded in obtaining large collections. He was particularly fortunate in catching five specimens of a fish of which only one small individual had heretofore been known, and that was obtained several years ago from a well in Lebanon, Tennessee. This fish, which Mr. Putnam had previously described from the Lebanon specimen under the name of *Chologaster agassizii*, is very different in its habits from the blind fishes of the cave and other subterranean streams, and is of a dark colour. It lives principally on the bottom, and is exceedingly quick in its motions. It belongs to the same family as the two species of blind fishes found in the cave. He also obtained five specimens of four species of fishes that were in every respect identical with those of the Green River, showing that the river fish do at times enter the dark waters of the cave, and when once there apparently thrive as well as the regular inhabitants. A large number of the white blind fishes were also procured from the Mammoth Cave and from other subterranean streams. In one stream the blind fishes were found in such a position as to show that they could go into daylight if they chose, while the fact of finding the *Chologaster* in the waters of the Mammoth Cave, where all is utter darkness, shows that animals with eyes flourish there, and is another proof that colour is not dependent on light. Mr. Putnam found the same array of facts in regard to the crayfish of the cave, one species being white and blind, while another species had large black eyes, and was of various shades of a brown colour. A number of living specimens of all the above-mentioned inhabitants of the waters of the cave were successfully brought to Massachusetts after having been kept in daylight for several weeks, proving that all the blind cave animals *do not* die on being exposed to light, as has been stated.

WE have received the *Annuaire* of the Belgian Academy for 1875. It contains the usual useful information concerning the organisation and work of the Society, the prizes it awards, list of members, &c. The principal memoir is that of Quetelet, mentioned in NATURE, vol. xi. p. 217, with a portrait; there are also memoirs, with portraits, of two other deceased members, Charles Poelman, the comparative anatomist, and H. L. F. Partoes, the architect.

THE additions to the Zoological Society's Gardens during the past week include an Australian Cassowary (*Casuarius australis*), new to the collection, from Australia, presented by the Marquis of Normanby; a Banded Cotinga (*Cotinga cincta*) and a Naked-throated Bell-Bird (*Chasmorhynchus nudicollis*), from Bahia, purchased; a King Vulture (*Gyparchus papa*) from Buenos Ayres, presented by Mr. M. Billinghurst; a Bonnet Monkey (*Macacus radiatus*) and a Macaque Monkey (*M. cynomolgus*), presented by Mr. H. Lumsden, a Rhesus Monkey (*M. erythreus*), presented by Mr. W. de Winton, and a Bonnet Monkey, presented by Miss M. Hailes, all from India; a Black-tailed Antelope (*Nanotragus nigricaudatus*) from West Africa, purchased.

ON THE MUSCULAR MECHANICAL WORK DONE BEFORE EXHAUSTION

MUSCULAR exertion may be either dynamical or statical. Dynamical work is generally intermittent, while statical work is generally continuous in its action. The dynamical work done by any muscle before exhaustion is easily measured in kilogrammetres. Assuming the force exerted by any muscle to be w, and if n be the number of times the force is exerted through the distance h, until exhaustion sets in, then the total work, W, done before exhaustion, is

$$W = w\,h\,n \qquad (1).$$

If, however, a weight, w, be supported on the horizontally outstretched arm, then by the above formula the amount of work is zero, although the arm soon tires out. In his "Principles of Animal Mechanics" pp. 24—44, London, 1873, Mr. Haughton has attempted to estimate the statical work thus done by the muscles of the arm. Let w = the weight, a = weight of arm, a = distance from centre of glenoid cavity to centre of weight, and t = time in seconds before exhaustion. The muscles exert a force capable of sustaining the weight of the loaded arm at its centre of gravity. Let θ be a small arc, through which the arm moves uniformly with an unknown angular velocity w in the time t. Then, if x is the distance from the centre of the glenoid cavity to the centre of gravity of the loaded arm, we have—

$$\text{Total work} = (w + a)\,x\,\theta$$

But since

$$(w + a)\,x = a\left(w + \frac{a}{2}\right),$$

and $\theta = w\,t,$ we shall have—

$$\text{Total work} = w\,a\left(w + \frac{a}{2}\right)t \qquad (2).$$

The values of (a) and (a) are easily obtained by direct measurement and weight. This formula (2) is, however, no better than (1), for when θ is zero, w is also zero, and the work would be nothing. Mr. Haughton has, however, used this formula, assuming $\omega = 1$, which value he has deduced from experiments made by myself (Prin. of Animal Mech., pp. 475—7), and published in the *School Laboratory*, 1871, vol. i. p. 108.* The experiments were conducted as follows:—

A weight w = 7·00 kilos. was lifted from a vertical to a horizontal with the shoulder, in a varying time t. At the instant the weight reached the horizontal, the muscles were relaxed, and the weight allowed to drop, being caught on a cushion attached to the leg. The intervals of work and rest, t, were in all cases equal. (I intend to repeat these experiments, making the interval of rest constant). Mr. Haughton has repeated my experiments, and has deduced the formula—

$$n = \frac{A\,t}{1 + \left(\frac{2\,\omega}{\pi}\right)^{t^2}} \qquad (3).$$

where n is the number of lifts before exhaustion. The observations for my right arm are given below.

TABLE I.

t	n (obs.)	n (calc.)	d per cent.	e per cent.
1·164	15·8	22·2	− 41	1·9
1·50	22·8	22·8	0	2·1
2·00	18·5	21·7	− 17	1·0
3·00	17·3	18·2	− 5	1·7
4·00	15·3	15·5	− 1	1·9
4·50	15·0	13·8	+ 8	1·3
5·00	14·3	12·6	+ 12	2·8
6·00	12·8	9·4	+ 27	3·1

The values of the constants in (3) as obtained by Mr. Haughto are, A = 30·4 and $\frac{2\,\omega}{\pi}$ = 0·666. Substituting these values, an the proper values of t in (3), and we have n (calc). Colum d is the difference in per cent. of n (obs.) Each value of n obs. is a mean of four determinations. The probable error of thi mean in per cent. of n (obs.) is given in column e. The experi ments of Prof. Haughton are more nearly represented by (3), but that they are in themselves more accurate, is, as will be seen, a matter of doubt. One of the deductions which Prof. Haughton makes from (3) is the determination of his so-called "angular velocity," $w = 0{\cdot}666\,\frac{\pi}{2} = 1{\cdot}0472$.* The mean value of w as determined from several observations is 1·00. Hence (2) becomes—

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* These experiments were merely published as a preliminary, in ord that I might pursue the investigation at my leisure.

$$\text{Total work} = a\left(w + \frac{a}{2}\right)t. \qquad (4).$$

Besides the difficulties already noticed, the conclusion arrived at in (4) is open to several fatal objections, a few of which I will detail.

1. In his reduction resulting in (3), Prof. Haughton assumes the truth of the following law (Prin. An. Mech., p. 442):—"When the same muscle (or group of muscles) is kept in constant action until fatigue sets in, the total work done, multiplied by the rate of work, is constant." By "rate of work" is meant the work per second. But in these experiments the muscles were not "kept in constant action," and even during the interval of work the action of the muscle constantly varies. The "rate of work" is therefore also entirely indefinite.

2. The method of experiment used by me, and which seems to have been followed by Prof. Haughton, I have found entirely unreliable, as will be hereafter shown.

3. Putting $\beta = \left(\frac{2\omega}{\pi}\right)^2$ in (3) and it may be reduced to the form—

$$\frac{n}{t} = A - \beta n t \qquad (3').$$

Anyone who will take the trouble to calculate and co-ordinate the values $\frac{n}{t}$ and $n\,t$ from Prof. Haughton's observations, pp. 468, 474, will see that these co-ordinated values form a curve, instead of a straight line. This is much more plainly marked in an unpublished series now in my possession. These latter experiments were made with an apparatus and method to be described in the next paper. They are more accurate than those before published, but not as accurate as can be obtained. It is certain, however, that the value of w in (3) is not constant. Assuming it to be constant, however, and its value in the series referred to, lies between 0·30 and 0·50. This illustrates very forcibly the futility of attempting theoretical reductions on the basis of assumed "laws," until we have first made sure of our facts.

Another series of mine which was also reduced by Prof. Haughton consisted in raising a varying weight, w, through the length of the arm in a time $t = 1{\cdot}164$ sec. The experiments were otherwise conducted as before described. Mr. Haughton makes use of the above-quoted law in this reduction, and finds the relation to be—

$$\left(w + \frac{a}{2}\right)n = \frac{A'}{\left(w + \frac{a}{2}\right)} \qquad (5).$$

For my right arm the constants are $A' = 1000$ and $a = 2{\cdot}0$. The comparison of n (calc.) and n (obs.) is satisfactory, and for want of space it is omitted. Solving (5) for n and making $w = 7{\cdot}0$, and making $t = 1{\cdot}164$ in (3), and the values of n are evidently identical, or—

$$Z\,\frac{A'}{(7{\cdot}0 + 1)^2} = \frac{A\,1{\cdot}164}{1 + \left(\frac{2\omega}{\pi}\right)^2 (1{\cdot}164)^2}$$

where Z should equal unity. Solving for Z and introducing the values of the constants, and we find $Z = 1{\cdot}41$. Although this discrepancy was pointed out to him, Prof. Haughton has transferred unreduced, from the observations leading to (5), the first value of n ($t = 1{\cdot}164$) in Table I. It is to be regretted that Prof. Haughton did not leave unpublished the last 43 pages of his interesting and valuable work.

FRANK E. NIPHER.

(*To be continued.*)

SCIENTIFIC SERIALS

THE current number of the *Journal of Anatomy and Physiology* commences with a suggestive description, by Dr. J. F. Goodhart, of three cases of malformation of the spinal column associated with lateral curvature, which lead him to the conclusion that cases of asymmetry of the two sides of the spinal column are due to original malformation of the bodies of the implicated vertebræ in the direction of a bi-lobed or double nucleus, and the subsequent unequal growth of the two halves.—Prof. Struthers has also a lengthy article on variations of the vertebræ and ribs in man, which will be read with interest in connection with that of Dr. Goodhart, and by all comparative anatomists, several very instructive abnormalities being described.—This paper is followed by one from the pen of Dean Byrne, on the development of the powers of thought in vertebrate animals in connection with the development of their brain; in which the author, by a comparison of the cerebral capacities of the different families of Mammalia with those of comparative anatomical structure and embryonic development, endeavours to prove that the functions of the anterior lobes of the brain belong to the act of thinking single objects of sense, those of the middle lobes to the act of thinking such objects with a sense of succession of them and as part of that succession, and those of the posterior lobes to the act of thinking a co-existence or succession of them as a case of a general principle.—Prof. M. Watson continues his contributions to the anatomy of the Indian elephant, describing the muscles and blood-vessels of the face and head. The same author also, with a drawing, describes a remarkable case of pharyngeal diverticulum, which opened on the free margin of the posterior pillar of the fauces, occupied the anterior triangle of the neck, and had a duct-like communication with its orifice, running between the internal and external carotids.—Dr. Arthur Ransome records the position of the heart's impulse in different postures of the body, from chest-rule measurements made by Mr. W. A. Patchett.—Baron A. de Watteville describes the cerebral and spinal nerves of *Rana esculenta*, from a series of dissections recently made.—Prof. Turner gives an account of the occurrence of *Phoca greenlandica* as a British species, from a specimen captured in Morecambe Bay and identified by Mr. T. Gough.—Mr. J. C. Ewart records notes on the minute structure of the retina and vitreous humour.—Mr. J. C. Galton also has a note on the Epitrochleo-anconeus or Anconeus Sextus (Gruber) as a supplement to Prof. Gruber's paper, giving drawings of it in *Tamandua tetradactyla*, *Cholopus didactylus*, *Phascolomys wombata*, and *Echidna setosa*.—The remaining short papers are by Mr. J. Reoch, on urinary pigments; by Dr. J. J. Charter, on abnormalities of the arteries of the upper extremity; by Mr. J. Harker, on a four-toed fœtus without head or upper limbs; and by Dr. J. Cantlie and Mr. Bellamy, on the absence of the quadriceps-femoris muscle, and on the presence of a sixth lumbar vertebra, the first rib being rudimentary.

THE *Scottish Naturalist* for January maintains the prestige of this interesting quarterly, now entered on its fifth year and third volume. It commences with an article of a more popular character than most:—"Illustrations of Animal Reason," by Dr. Lauder Lindsay, the authenticity of the anecdotes being vouched for by the writer. Among the botanical notes, the most interesting is that of the discovery in Aberdeenshire by Mr. Sadler, during an excursion of the "Scottish Alpine Club," of two plants new to Britain, *Carex frigida* and *Salix Sadleri*, the latter now described for the first time, and probably a hybrid between *S. reticulata* and *S. lapponum* or *lanata*. We have further instalments of "The Lepidoptera of Scotland," by Dr. Buchanan White, and "The Coleoptera of Scotland," by Dr. Sharp.

Poggendorff's Annalen der Physik und Chemie, 1874, No. 11.—The first paper is by W. Müller, of Perleberg, on the reduction of metallic oxides by hydrogen, and the application of this process for the quantitative determination of metals. The value of this method of quantitative determination depends on the fact that hydrogen reduces different metallic oxides at different temperatures. The results of Müller's experiments show that the quantities of several metallic oxides may be determined in this way, when the mixtures are heated in hydrogen, and care is taken with regard to regulation of temperature. The method proved successful for copper and zinc, copper and silver, copper and bismuth, copper and cadmium, copper and lead, copper and tin, copper and iron; also for copper, iron, and zinc, and pretty well for copper, cadmium, and zinc; but it was unsuccessful in the case of silver and iron, silver and lead, arsenic and antimony. The apparatus is simple enough, but the experiments take a very long time, and will not be of much general practical use.—The next paper records some thermo-electric studies by E. Budde.—Dr. Kurd

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* A few of these decimals might be dropped without impairing the accuracy of the result.

Lasswitz, of Breslau, contributes an article on the decay of the "kinetic atomic theory" in the seventeenth century.—Another communication is by Dr. H. Streintz, of Vienna, on torsion-oscillations of wires. It is followed by a paper on resistance in galvanic conductors, by H. Herwig. This paper was accidentally delayed, and should have been published before another one on the same subject, which appeared in Part 1874, No. 9, of these Annals.—The next paper, on fluorescence, by O. Lubarsch, is highly interesting. The author gives an account of elaborate investigations he made on the subject, with special reference to spectrum analysis; his general results seem to show (1) that for each fluorescent substance there are only certain rays of light causing fluorescence; (2) that the colour of the fluorescent light depends on the rays of incidence, and follows Stokes's law; and (3) that the most refrangible fluorescent rays, produced by sunlight, correspond to that place in the spectrum where the liquid shows its maximum of absorption, providing its fluorescence proves a simple one, when examined by prismatic analysis of the linear spectrum. In all three points Mr. Lubarsch differs from Pierre and Lommel, who investigated the subject before him.—On the expansion of mercury after Mr. Regnault's experiments, is a valuable communication from Mr. A. Wullner.—The remaining papers are: On the influence of the temperature of air on the index of refraction, by M. V. von Lang; and on the oblique passage of rays through lenses with reference to a peculiarity of the crystalline lens, by L. Herman.—Besides these, there is a short note by H. Schneebeli, on Hipp's machine for determining the laws of motion.

Der Naturforscher (Nos. 49-52, Dec. 1874.)—Among the papers in this number we note the following:—On currents and temperatures in the Atlantic Ocean; observations made on board the German corvette *Gazelle*, by the commander Herr von Schleinitz, on a voyage to the Kerguelen Islands.—On carnivorous plants; researches made by Prof. Ferd. Cohn, of Breslau, with European species.—Note on the discovery of a new asteroid, 139, on Oct. 13, 1874, by Mr. J. Palisa, at Pola. It appeared of the 11th magnitude, under R.A. 2h. 7m. 19·39s.; Decl. +7° 29′ 50·7″.—On the native iron of Ovifak, Greenland; discussing the question whether this native iron is of meteoric or terrestrial origin.—On the influence of temperature upon the respiration of plants; researches made by Herren von Wolkoff and Mayer at Heidelberg, showing that the influence is not nearly so great as is generally accepted.—On the formation of urea in the animal organism, by Herr von Knieriem.—On attraction and repulsion by heat and light, by A. Bergner; account of experiments made, which led to different results than those obtained by Mr. Crookes.—On the decrease of intensity in the light of Jupiter's satellites when passing over the planet's disc. This was explained by S. Alexander as resulting from interference and absorption of the rays of light; H. J. Klein now gives a much simpler explanation.—On the inorganic cell and the phenomena of growth in the inorganic world, by M. Traube; giving a purely physical explanation for the origin and growth of the cell.—Besides many smaller notes of scientific interest, the last number contains a detailed account of the sledge journeys made by Oberlieutnant Jul. Payer while in polar regions with the Austrian Polar Expedition.

SOCIETIES AND ACADEMIES

LONDON

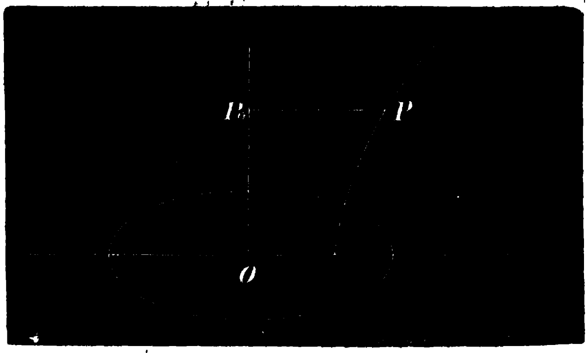
Royal Society, Jan. 21.—"On the Origin and Mechanism of Production of the Prismatic (or columnar) Structure of Basalt," by Robert Mallet, C.E., F.R.S., &c.

In this paper the author shows that all the salient phenomena of prismatic basalt as observed in nature can be accounted for as results of contraction by cooling in a homogeneous body possessing the properties of basalt, and that the theories hitherto advanced and repeated in text-books of the production of basaltic prisms are alike untenable and unnecessary. If a large level and tabular mass of homogeneous basalt cool slowly by loss of heat from one or more of its surfaces, the contraction of the mass while plastic will be met by internal movements of its particles; but when the temperature has fallen to a certain point of rigidity reached at between 900° and 600° F., splitting up commences, and that surface will begin to divide itself into similar geometric figures of equal area, which on mechanical principles must be hexagons, the diameter of which is shown to depend upon the relation that subsists between the coefficients of extensibility of the material and of its contraction by cooling down to the splitting temperature. These hexagons are the first formed ends of the future prisms, which split deeper into the mass as cooling down to the splitting temperature reaches deeper into it. When the prisms have split down to a certain distance, further cooling proceeds, not only from the ends of the prisms, which formed the surface of original cooling, but from the sides of the prisms. Now, as each prism is coldest at the end, and hottest where in the act of splitting, and is also hotter along the axis than at the exterior of each prism, so, by contraction, differential strains are produced in each prism, both parallel to the axis and transverse to it, which result in cross fractures at intervals along the length of the prism, the distances between which the author has assigned. Transverse fracture round the prism must commence in the outer *couche* in a plane normal to the resultant of the contractile strains longitudinal to and transverse to the axis of the prism; the fracture commences, therefore, oblique to the prismatic axis. This obliquity diminishes as the transverse contractile force diminishes, as the circumferential *couche* of cooling reaches nearer to the axis of the prism; the result is that the transverse fracture when completed is lenticular or cup-shaped, the convex surface always pointing in the same direction in which the cooling is progressing within the mass.

If the mass cool from the top surface only, the convex surfaces of the cup-shaped joints will all point downwards; if cooled from the bottom only, they will point upwards; and if from both surfaces, the convexity of the joints will be found pointing both upwards and downwards in the mass. As the splitting always takes place normal to the surface of cooling, so, if that surface be level and cool, uniformly, the prisms must be vertical and straight; also, if the cooling surface be a vertical or inclined one, the direction of the prisms will be normal thereto. If, however, the mass cool from its upper or lower surface, but of much greater thickness in one direction than in the opposite one, the prisms formed will not be straight, but have their axes curved, because the successive couches reaching the splitting temperature successively within the mass, and normal to which the splitting takes place, are themselves curved planes. These are a few of the principal points of this paper, which the author believes renders, for the first time, a complete and consistent account of all the phenomena observed in prismatic basalt. A considerable number of these phenomena were referred to and explained by the author. At the conclusion of his paper the author submits to rigid examination the notions which from 1804, the period of Mr. Gregory Watts's paper (Phil. Trans.), to the present time, have continued to occupy the text-books of geologists, and he points out how entirely these fail to account for the phenomena.

Linnean Society, Jan. 21.—Dr. G. J. Allman, F.R.S., president, in the chair.—Dr. Hollis read a paper on the pathology of oak-galls. Oak-galls may be divided into two classes, the unilocular or one-celled, which include the woody marbled oak-galls, the ligneous galls of Réaumur, and the currant leaf-galls; and the multilocular or many-celled, including the spongy oak-apple and the oak-spangles of the leaves. The author went with some detail into the structure and history of development of each of these kinds, taking a few examples of each. With the exception of the oak-spangles, all the different kinds appear to be formed during the growth of the leaf. The pathological differs from the healthy development in the more rapid growth of its cellular elements and in the larger size they attain; this is gained at the expense of the differentiation of the matrix of the bud. The author traced the origin of the different layers of the gall itself to the different layers of the leaf from which it is produced. A discussion followed, in which the President, Mr. Murray, Mr. Howard, Prof. Dyer, and others took part.—The following papers were then read:—Reports of the *Challenger* Expedition; On the Lichens, chiefly of Tristan d'Acunha, by the Rev. Dr. Stirton.—On the Lichen Flora of New Zealand and Chatham Island, by the Rev. Dr. Stirton.

Mathematical Society, Jan. 14.—Prof. H. J. S. Smith, F.R.S., president, in the chair.—Mr. J. W. L. Glaisher gave an abstract of a paper by Prof. Cayley, on the potentials of ellipses and circles. The potential of an ellipse of uniform density (in regard to a point not in the plane of the ellipse) was found by a process similar to that made use of in Gauss' memoir, "Determinatio attractionis quam exerceret Planeta," &c. (1818); the final result resembled in a remarkable manner the formula for the potential of an ellipsoid. The author then deduces a



remarkable result relating to the particular case where the attracted point P is in the focal hyperbola of the ellipse, viz.: if we consider the semi-axis minor as constant, but the semi-axis major (and therefore also the focal hyperbola) as variable; and take the point P, always in the focal hyperbola, at a constant altitude above the plane of the ellipse; then the potential remains constant. The potential of the circle is of course included in the general formula for the ellipse, but there are some special investigations which are developed in detail in the paper.—Mr. Glaisher then proceeded to give a sketch of a second paper by Prof. Cayley, on the attraction of an ellipsoidal shell. The shell in question is the indefinitely thin shell of uniform density included between two similar and similarly situated ellipsoidal surfaces. It was known for a long time that the attraction of such a shell on an internal point was equal to zero; and in 1833 Poisson showed analytically that the attraction on an external point was in the direction of the normal to the confocal ellipsoid through the attracted point, or (what is the same thing) in the direction of the axis of the circumscribed cone having the attracted point for its vertex. In 1834 Steiner gave a very elegant geometrical demonstration of Poisson's theorem, but did not attempt to complete the solution so as to obtain the attraction of the shell. This was done two years ago by Prof. J. C. Adams, F.R.S., who gave the solution at a lecture given in Cambridge. The result (which in the present paper is worked out in a different way) comes out with great simplicity, and we obtain, *without any process of integration*, for the attraction of the shell a finite expression which coincides with known formulæ, and which leads very easily to the known formulæ for the attraction of a solid ellipsoid.—Mr. J. Hammond read a paper on the solution of linear differential equations in series. He first takes the general equation and expands y in a series of determinants, the n arbitrary constants being the first n differential coefficients of y when x is put equal to zero, the particular integral being also expanded in a series of determinants. He then gives expansions of the same form for $\frac{\psi(x)}{\phi(x)}$ and $\frac{1}{\phi(x)}$ and a value of the mth differential coefficient of $\frac{\psi(x)}{\phi(x)}$ in the form of a determinant of $m + 1$ rows. And lastly, he considers two particular cases of the expansion of y in series from its differential equation.—Major J. R. Campbell exhibited two "Mechanical Calculators." The instrument is little more than a development of the circular slide scale in which two principles are engaged in one arrangement: (1) that of the common slide scale; (2) that of the scale invented by the late Dr. Roget (see article "Slide Scale," by De Morgan, in the "Penny Cyclopædia.) The designer described the construction and application of the instrument, and having been thanked by the chairman for his communication, presented both instruments (which were constructed with extreme neatness of penmanship) to the Society. Major Campbell also presented his description of the instrument to the Society, containing notes on its manufacture, tables of logarithms, and log-logarithms employed in the construction.—Mr. J. J. Sylvester, F.R.S., made a brief communication on the representation of any unicursal curve and its nodes in terms of the parametric coefficients, and on Roberts' and Hart's cases of unicursal 3-bar motion. M. Camille Jordan spoke on the subject of Mr. Sylvester's communication

Zoological Society, Jan. 19.—Mr. Robert Hudson, F.R.S., vice-president, in the chair.—The Secretary called attention to a letter received from a correspondent in Ternate, Moluccas, in which it was stated that the writer had living examples of four species of Paradise Birds in his possession, namely, of *Paradisea papuana*, *Seleucides alba*, *Diphyllodes speciosa*, and *Ptilorhis magnifica*.—A communication was read from Mr. J. Brazier, of Sydney, N.S.W., giving descriptions of ten new species of Australian shells, from the collection of Mr. A. Coxen, of Brisbane, Queensland.—Mr. A. G. Butler read descriptions of four new species of butterflies of the genus *Protogonius*, belonging to the collection of Mr. H. Druce.—A communication was read from Messrs. P. L. Sclater and O. Salvin, giving descriptions of three new species of South American birds. These were proposed to be called *Microcerculus squamulatus*, *Automolus striaticeps*, and *Tigrisoma salmoni*.—Prof. Newton, F.R.S., gave an account of a MS., in the French Archives de la Marine, which contained some additional evidence as to the original fauna of Rodriguez, and called special attention to the unknown writer's account of the terrestrial birds of that island, amongst which were mentioned the "Solitaire," the *Erythromachus leguati* of A. Milne Edwards, and other now extinct forms.—A communication was read from Dr. A. B. Meyer, director of the Royal Natural History Museum, Dresden, containing the description of a new Bird of Paradise, skins of which had been sent to him by Mr. van Musschenbroek, the Dutch Resident at Ternate, and which it was proposed to call *Diphyllodes Gulielmi* III. The habitat of this new bird is stated to be the inner mountains of Eastern Waigiou.—A communication was read from Major H. H. Godwin-Austen, containing supplementary notes on a former paper on the species of *Helicidæ*, of the sub-genus *Plectopylis*.

Meteorological Society, Jan. 20.—Dr. R. J. Mann, president, in the chair.—After the Report of the Council had been read by the Secretary and adopted, the President delivered his address, in which he dwelt in detail upon the various important and useful measures that had been carried out by the Society during the past year, and in doing so alluded to the action of the Maritime Conference in forwarding uniform and consentaneous operations on the part of meteorologists; the establishment of a uniform system of record, by the combined action of the Society and the Meteorological Office of the Government, which has been adopted by the Army Medical Department; and the starting of a considerable series of authorised and carefully inspected observatories, which have been planned upon a geographical base, so as to give a comprehensive grasp of the meteorology of England, and so as to enable returns to be periodically made which will present at a glance the leading features of climate and season. The value of these stations, it was pointed out, had been very materially increased by a system of concerted action which had been agreed upon between the Meteorological Society and the Meteorological Office of the Government, and which it was intended to extend as the best and most available situations for other observatories could be determined upon. The President next spoke of the large addition that had been made to the usefulness of the Society by the acquisition to its ranks of a considerable number of the most distinguished meteorologists of foreign lands; of the importance of a scientific alliance with the Public Officers of Health, who are now so closely connected with meteorological investigations; of the influence of exceptional seasons upon the health of the community; of investigations in progress with the climate, and especially the winter climate, of London, now of daily importance to some three millions and a half; of systematic observations of the influence of seasons upon animals and plants; of the formation by the Society of a library of standard meteorological works; and of the introduction of close study of the physical condition and aspects of the sun in connection with changes of weather and vicissitudes of season, a subject which is now getting to be of surpassing interest on account of the brilliant discoveries and marvellous deductions that have recently been made in this noble branch of scientific research. The following gentlemen were elected Officers and Council for the ensuing year:—President, Robert James Mann, M.D., F.R.A.S. Vice-Presidents: Charles Brooke, M.A., F.R.S., F.R.C.S., Henry Storks Eaton, M.A., Rogers Field, B.A., Assoc. Inst. C.E., Capt. Henry Toynbee, F.R.A.S. Treasurer, Henry Perigal, F.R.A.S. Trustees: Sir Antonio Brady, F.G.S., Stephen William Silver, F.R.G.S. Secretaries: George James Symons, John W. Tripe, M.D. Foreign Secretary, Robert H. Scott, M.A., F.R.S. Council: Percy Bicknell, Charles O. F. Cator, M.A., Cornelius Benjamin Fox, M.D., Frederic Gaster, William John Harris, M.R.C.S., James Park Harrison, M.A., John Knox Laughton, M.A., F.R.A.S., Robert J. Lecky F.R.A.S., William Carpenter Nash, Rev. Stephen J. Perry, M.A., F.R.S., William Sowerby, E. O. Wildman Whitehouse, F.R.A.S., Assoc. Inst. C.E.

Physical Society, Jan. 16.—Prof. Gladstone, F.R.S., in the chair.—A paper was read on the electrolysis of certain metallic chlorides, by the President and Mr. Alfred Tribe. If metallic copper be immersed in solution of cupric chloride, insoluble cuprous chloride is formed upon it. The authors found that if a strip of platinum be connected with one of copper and the two immersed, the insoluble cuprous salt was also deposited upon the platinum. Attributing this result to the electrolysis of the cupric salt by a feeble current, they tried the effect of a zinc-platinum cell excited by common water and with two platinum electrodes in the cupric chloride. Cuprous chloride appeared at the negative electrode and chlorine at the positive. An ordinary Grove's cell also gave cuprous chloride for the first two or three minutes, but afterwards metallic copper. A zinc and a platinum plate were joined and immersed in the cupric chloride; cuprous chloride was deposited upon the platinum, the edges being also incrusted with metallic copper. With magnesium in place of the zinc, a larger proportion of copper was obtained. Mercuric and ferric chlorides being analogous to those of copper, induced the authors to experiment with them also. Precisely analogous results were obtained, mercurous and ferrous chlorides appearing at the negative electrode.—A communication was made by Prof. Guthrie on "Salt Solutions and attached Water." Continuing the direction of research previously indicated, and the results of which were communicated to the Society in November last, the author described the following facts:—Contrary to the generally received opinion, the minimum temperature attainable by mixing ice with a salt is very independent of the ratio of the two and of their temperature, and of the state of division of the ice. The temperature of a mixture of ice and a salt is as constant and precise as the melting-point of ice. The nine salts resulting from the union of potassium, sodium, and ammonium, on the one hand, and chlorine, bromine, and iodine on the other, were examined in reference to their cryohydrates, the temperatures of the formation of which range from − 28 to − 11. For the same halogen, sodium salts assume less water than ammonium, and ammonium less than potassium. For the same metal, iodine salts assume less water than bromine, and bromine salts less than chlorine. The result of the examination of thirty-five salts establishes the identity of the temperature at which the cryohydrate is formed with the temperature got by mixing the salt with ice. Only two apparent exceptions to this identity have been as yet observed. The temperature at which a cryohydrate is formed is, with similar salts, lower, according as it assumes a less molecular ratio of water. There appear to be no exceptions to the rule that the lower the temperature got by mixing the salt with ice, the lower the molecular ratio of water. The temperature of incipient solidification of spirits of wine of different strengths was also examined. It was found that from spirits containing more water than the four hydrate, pure ice was separated, and that the temperature gradually sank to - 34° C., when the ratio of the four hydrate was reached. Thence the temperature remained constant, and the whole solidified into a hard mass. When a spirit richer than this cryohydrate is cooled, the cryohydrate separates, and a stronger and stronger spirit is left, which ultimately defies the source of cold (solid carbonic acid) to solidify it. Prof. A. Dupré's experiments regarding the maximum temperature produced on diluting alcohol are thus singularly confirmed. For this experimenter showed that this very four molecule ratio produced the greatest heat in its formation. Ethylic ether, which dissolves water and is dissolved by it, seems to form a definite cryohydrate. Water saturated with ether solidifies at −2° C., without separation of ether. The icy mass when ignited burns with a colourless flame, the heat of which just suffices to melt the ice.

PARIS

Academy of Sciences, Jan. 18.—M. M. Fremy in the chair.—The following papers were read:—On the saline matter which the sugar-beet takes up from the soil and from manure, by M. E. Peligot; experiments which the author made with ten specimens of beet, all treated differently with regard to soil and manures, and tables of results obtained when analysing their ashes.—On the temperatures under turf or naked ground during the late frost, by MM. Becquerel and E. Becquerel.—A note by M. de Lesseps, on a project of communication between France and England, by means of a submarine tunnel, with an extract of a detailed account of this project as presented to the French National Assembly. M. Dupuy de Lôme then spoke against this project, and expressed himself in favour of a channel railway ferry.—On the *régime* of the principal rivers in the north, centre, and south of France, by M. Belgrand.—A note on M. Gosselin's paper of the last meeting (see NATURE, vol. xi. p. 240) with regard to unmovable dressings of wounds, by M. Ollier. Baron Larrey then made some further remarks on the subject.—On the first method of Jacobi for the integration of equations with partial derivatives of the first order, by M. G. Darboux.—On a system of tangential co-ordinates, by M. Casey.—On the deposits of flint implements near Précy-sur-Oise, and the presence of great pachydermata in the diluvium of the same locality, by M. E. Robert.—A note by M. de Lontin, on his ameliorations of dynamo-electric machines.—A note by M. Bonneil, on an aëronautical apparatus.—A note by M. E. Duchemin, on a new compass that can be used on the surface of liquids, and gives the time by the sun.—A note by M. C. Beuchot, on the application of steam for canal and river navigation.—On the causes of wear and tear and explosions of steam-boilers, by M. F. Garrigou.—MM. Blandin, Baruzzi, Mosca, and Guillaumont, sent some communications on Phylloxera.—The Minister for Foreign Affairs transmitted to the Academy some documents received from the French Consul at Mauritius, on the results obtained by Lord Lindsay in the observation of the transit of Venus. The French Consul at Honolulu sent some details on the same subject with regard to observations made by English expeditions at Honolulu, Hawai, and Kanai.—A letter from the Minister for Agriculture and Commerce, drawing the attention of the Academy to the steps that ought to be taken to prevent the invasion into France of the fly *Doryphora*, which attacks the potato plantations in the United States.—On the notion of general systems of algebraic or transcendent surfaces, deduced from that of *implexes* of surfaces, by M. G. Fouret.—On the stellar system, 61 Cygni, stars physically related, the relative motion of which is not an orbit but rectilinear, by M. Flammarion.—Account of the discovery of asteroid (141), at the Paris Observatory, by M. P. Henry.—On the ammonia in the atmosphere, by M. A. Schloesing.—Researches by M. Muntz, on the respiratory functions of fungi.—On the decomposition of Fehling's liquor, and the admixture of glucose in the presence of sugar, by MM. P. Champion and H. Pellet.—On the pulsations of the heart, by M. Marey.—On the carrying along of air by a steam or air jet, by M. F. de Romilly.—On the phenomena of mineral and organic localisation with animals, and their biological importance, by M. E. Heckel.—On the development of Pteropoda, by M. H. Fol.—The neutralisation of the acidity of chloral hydrate by carbonate of soda retards the coagulation, while it preserves the physiological properties, by M. Oré.—Researches on the silicified plants of Autun and Saint-Etienne, by M. B. Renault, with special reference to the genus Botryopteris.—On the influence of forests upon rivers and the hygrometric state of the atmosphere, by M. L. Fautrat.—On the breaking of vessels by the freezing of water, by M. A. Barthélemy.—During the meeting the Secretary announced the sad loss the Academy had sustained through the death of M. d'Omalius d'Halloy, of Brussels, correspondent of the Academy's Mineralogical Section. M. C. St. Claire-Deville then spoke a few words in memory of the deceased.

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LONDON

THURSDAY, JANUARY 28.

ROYAL SOCIETY, at 8.30.—On the Theory of Ventilation; an Attempt to establish a positive Basis for an inhabited Air-Space: Dr. F. S. B. Francois-de-Chaumont.—On the Atmospheric Lines of the Solar Spectrum, illustrated by a Map drawn on the same scale as that adopted by Kirchhoff: J. B. N. Hennessey.

SOCIETY OF ANTIQUARIES, at 8.30.—On Recent Excavations in the Roman Forum: F. M. Nichols, M.A., F.S.A.

ROYAL INSTITUTION, at 3.—Physical Geography: Prof. P. M. Duncan, F.R.S.

LONDON INSTITUTION, at 7.—First Musical Lecture: Prof. Ella.

FRIDAY, JANUARY 29.

ROYAL INSTITUTION, at 9.—Recent Work of the *Challenger* Expedition: Prof. Huxley, F.R.S.

JUNIOR PHILOSOPHICAL SOCIETY, at 7.30.—The Crusades and their connection with the society of the Middle Ages: L. Franklin.

SATURDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—Discoveries at Ephesus: J. T. Wood.

PHYSICAL SOCIETY, at 3.—On Electrical Theories: Dr. A. Schuster.—On an Optical Bench: C. Becker.

SUNDAY, JANUARY 31.

SUNDAY LECTURE SOCIETY, at 4.—The impending Contact of Mongolian and Caucasian Races; M. Macfie.

MONDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 2.—General Monthly Meeting.

LONDON INSTITUTION, at 5.—Functions of the Brain: Prof. Ferrier.

SOCIETY OF ARTS, at 8.—Cantor Lecture; Alcohol, its Action and Use: Dr. B. W. Richardson, F.R.S.

VICTORIA INSTITUTE, at 8.—The Indestructibility of Force: Prof. T. R. Birks

ENTOMOLOGICAL SOCIETY, at 7.—On Entomological Nomenclature, with reference to Mr. Kirby's communication thereon in the *Canadian Entomologist*: W. Arnold Lewis, F.L.S.

TUESDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 3.—Pedigree of the Animal Kingdom: E. Ray Lankester.

ZOOLOGICAL SOCIETY, at 8.30—On the Kangaroo called *Halmaturus luctuosus* by L. M. d'Albertis, and its affinities: A. H. Garrod.—On some rare Parrots living in the Society's Gardens: Mr. Sclater.

WEDNESDAY, FEBRUARY 3.

SOCIETY OF ARTS, at 8.

ROYAL SOCIETY OF LITERATURE, at 8.—On the Classification of MSS., chiefly in relation to the Classed Catalogue in the British Museum: Walter de Gray Birch.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Anniversary Meeting.

THURSDAY, FEBRUARY 4.

LINNEAN SOCIETY, at 8.

ROYAL INSTITUTION, at 3.—Subjects connected with Electricity: Prof. Tyndall, F.R.S.

LONDON INSTITUTION, at 7.—The Grotesque in Indian Art: Dr. Zerffi.

TORQUAY

MONDAY, FEBRUARY 1.

NATURAL HISTORY SOCIETY, at 12, noon.—Curiosities of Animal Life: Dr. C. Paget Blake.

LEEDS

TUESDAY, FEBRUARY 2.

NATURALISTS' FIELD CLUB, at 8.—Exhibition of Specimens and Conversation.

EDINBURGH

THURSDAY, FEBRUARY 4.

GEOLOGICAL SOCIETY, at 8.—On the Physical Geology of the District between the Bathgate and Pentland Hills: Andrew Taylor.—On some Fossil Fishes from the neighbourhood of Edinburgh: R. H. Traquair, M.D., F.G.S.—On some Geological Sections in the North-West Highlands: James Bryce, LL.D., F.G.S.

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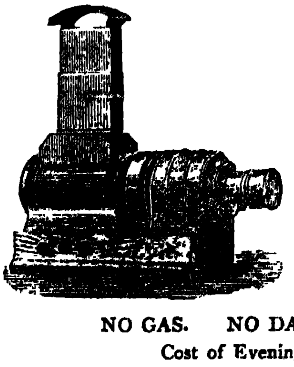

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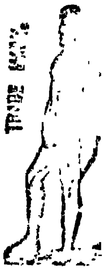

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„ IX.—THE INHABITANTS OF THE CAVES OF NORTH-WESTERN EUROPE, AND THE EVIDENCE OF THE FAUNA AS TO THE ATLANTIC COAST-LINE.
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„ XI.—THE EUROPEAN CLIMATE IN THE PLEISTOCENE AGE.
„ XII.—CONCLUSION.

APPENDIX I.—ON THE INSTRUMENTS AND METHODS OF CAVE-HUNTING.
„ II.—OBSERVATIONS ON THE ACCUMULATION OF STALAGMITE IN THE INGLEBOROUGH CAVE.

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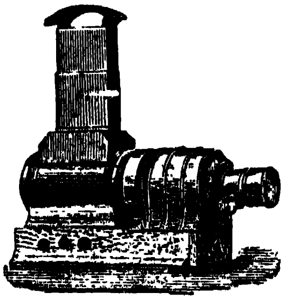

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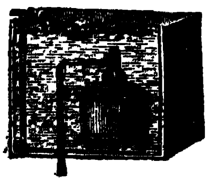

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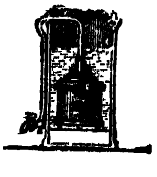

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THURSDAY, JANUARY 21, 1875

DR. LLOYD'S "TREATISE ON MAGNETISM"

A Treatise on Magnetism, General and Terrestrial. By Humphrey Lloyd, D.D., D.C.L., Provost of Trinity College, Dublin. (London: Longmans and Co., 1874.)

AN observational science like meteorology or terrestrial magnetism is placed in some respects at a disadvantage when compared with the more experimental branches of physical inquiry. It is often difficult to obtain a good and readable account of that which has been done. The reason of this is, that those who are personally engrossed with the science have to deal with such large masses of figures and precise measurements that they are frequently unable to spare the time necessary to give a good historical account of their favourite research. Those again who are the historians of science find it a very formidable task to bring themselves *en rapport* with all that has been done in such a subject as terrestrial magnetism—in fine, there is not sufficient inducement to undertake the task. No doubt, when such a science is more advanced and has attained a position like that of astronomy, it will find plenty of historians; but in its infancy, and when a good *résumé* of the progress already made is of peculiar value, it has comparatively few friends. Now these are precisely the circumstances when a Government or a University is able to interfere with very great effect, and with respect to terrestrial magnetism this opportunity has been admirably used by Trinity College, Dublin. The Rev. Dr. Lloyd tells us in his preface that the Dublin Magnetic Observatory was founded and placed under his superintendence by the governing body of Trinity College in 1838. This college has been peculiarly fortunate in having chosen as an observer the eminent physicist who is now its provost, and who, besides reaping much fame as a practical magnetician, has at length found leisure to present us with the much-required treatise on terrestrial magnetism.

The first part of this work refers to the general phenomena of magnetism, and contains one of the clearest accounts of the elementary laws of this subject which we have ever read. Some of the experiments recorded we do not remember to have seen anywhere else.

One of the most interesting preliminary chapters is that on the effects of temperature. It is well known that heat has a very peculiar effect upon all magnets. The following paragraph from Dr. Lloyd's work will explain the particulars of this action:—

> "Heat is also found to weaken the coercitive force of iron, and therefore to facilitate its magnetisation and demagnetisation. When a bar of iron is heated and exposed to the inductive action of a strong magnet, the magnetism developed is augmented. This effect increases up to a *dull red* heat, at which it is a *maximum*. At a *bright red* heat the capability of induction ceases altogether. *Cast-iron* and *steel* present the same results. The maximum force imparted to soft iron has been found by M. Ed. Becquerel to be 1·04, that imparted at the ordinary temperature of the air being unity; and it is a remarkable circumstance that the maximum force induced in *cast-iron* and in *steel* is precisely the same as that of *soft iron*, although at ordinary temperatures their induced magnetisms are very different. It appears from these facts that the coercitive force of these bodies vanishes altogether at a *dull red* heat" (p. 23).

Although it may be convenient to speak of the magnetic fluid, yet we think there can be little doubt that in a magnet we have directed molecular motion of some kind. This, we believe, is the hypothesis held by Sir W. Thomson and other physicists. The author of this notice has ventured to bring forward certain views as to the action of heat in destroying all directed motion. We know, for instance, that the conduction of electricity and of heat, two forms of directed molecular motion, is more resisted at high than at low temperatures. The analogy urged to explain this was that of a carriage or train in motion, on a road lined with passengers who were constantly entering at the one side while they were passing out of it at the other.

A stream of passengers of this nature would have the effect of bringing the directed motion of the train ultimately to rest. Now, heat may affect directed molecular motions in the same way, carrying into the train matter which does not partake of the motion of the train, and carrying out of the train matter which does partake of this motion, and so weakening the velocity of the train. Even visible directed motion may be influenced in this way, and it does not seem improbable that the etherial medium may act after this fashion in stopping the differential motions of the universe.

Now the question arises, is it likely that we have any action of this nature traceable in the effects of heat upon magnetism? Let us again quote from Dr. Lloyd as to certain peculiarities of the action of heat:—

> "When the heat applied to a steel magnet is moderate—when, *e.g.*, it does not exceed that of boiling water—part of the magnetism which had disappeared on the increase of temperature reappears when the original temperature is restored. It follows from this that heat produces two effects, which (in the present state of our knowledge) must be considered as distinct.
>
> "Like mechanical action, it permanently *destroys* a portion of the existing magnetism by enabling the two magnetisms which had been separated in each molecule to recombine. And, on the other hand, it *renders latent*, or neutralises, another portion of the same magnetism, which portion reappears again when the temperature is reduced to its original state.
>
> "This two-fold operation of heat, although fully recognised as a fact, has not been sufficiently considered in reference to the cause. There seems reason to believe that the two effects, so dissimilar in their conditions, are, in fact, referable to distinct causes; and that while the permanent loss of magnetism is a *dynamical effect* due to the *molecular movement* in which heat is known to consist, the recoverable portion is probably to be ascribed to the *dilatation* of the body and to the diminution of the reciprocal action of the magnetic elements consequent upon their increased distance."

We quite agree with Dr. Lloyd in his remarks on these two effects of heat, and would venture to supplement them with a suggestion as to the possibility of regarding the *dynamical effect* of heat as due to the introduction of new matter—new passengers, as it were—into the directed train of magnetic motion. If this view be tenable, we may perhaps imagine that a permanent loss of magnetism will be occasioned by every change of temperature of the magnet, whether this be from a lower temperature to a higher or from a higher temperature to a lower; in fact, as far as we can see, all the experiments hitherto made are just as compatible with this supposition as with that which attributes a permanent loss of magnetism only to an increase of temperature.

We now come to the most valuable part of the work, or those chapters which treat of terrestrial magnetism. Dr. Lloyd tells us in his preface that the course he has pursued has been "to present the results obtained at a single station, *i.e.* Dublin, at which all the general features of the phenomena belonging to the middle northern latitudes were fully developed, and to supplement the information by the results of observation at places widely removed from the former in geographical position, as well as in their relation to the sun's daily and yearly courses."

Dr. Lloyd adds that "he has not entered upon the interesting speculation connected with the physical causes of the phenomena, further than to reprint a paper, published by himself many years ago, in which the agency of the sun and moon are shown not to be due to their direct operation as magnetic bodies." And he concludes his preface by remarking that "the electrical earth-currents must have their effect upon the magnetical variations recorded in our observatories, whether they be the sole, or only a co-operating cause."

Are we justified in our inference, from the concluding observation, that Dr. Lloyd has to some extent modified his views with regard to the importance of these earth-currents? for, if we are not mistaken, he was at one time inclined to attribute the daily variations of terrestrial magnetism to their operation.

Speculations regarding the causes of the phenomena of terrestrial magnetism may be divided into two classes: firstly, those which attempt to account for the magnetisation of the earth; and secondly, those which only pretend to account for the changes taking place in this magnetisation. It is from the latter point of view that we would now venture to make a few remarks.

Let us assume, to begin with, that nothing is definitely known regarding the causes of these changes. Let us next endeavour to enumerate and discuss the various agencies we know of which may be conceived to take a part in producing these phenomena, in the hope that by a preliminary trial of its kind we may, perhaps, light upon the true cause, even although the evidence at our disposal be insufficient to give certainty to our suspicions.

In the first place, we may take it for granted that neither the sun nor the moon can cause the changes in terrestrial magnetism, which they are known to produce, by virtue of their direct magnetic influence.

This point has been sufficiently discussed both by Dr. Lloyd and by Mr. Chas. Chambers, and the conclusion to which both of these magneticians have arrived is, that the magnetic effects caused by the sun and moon are not due to their direct operation as magnetic bodies.

Let us take the sun and confine ourselves in the meantime to the daily variations which he causes. Now, first of all, it is clear that these are not due to any kind of tidal action of the sun, or to the indirect consequences of such an action, inasmuch as there is only one maximum and one minimum in the day.

The only other known way in which the sun can affect the earth is through his heat; and starting with the assumption that the earth *is* a magnet, no matter how or why, let us next enumerate the various ways in which the heat of the sun may possibly affect the earth.

In the *first* place, it might influence the magnetic properties of that medium (the air) which surrounds the earth and any suspended magnet.

Or, *secondly*, it might produce a temperature effect upon the earth itself considered as a magnet.

Or, *thirdly*, it might be conceived to generate thermo-electric currents in the earth.

Or, *fourthly*, it might cause the motion of conducting bodies across the earth's lines of magnetic force.

The first of these is the hypothesis of Faraday; and while the change produced by heat in the magnetic qualities of the atmosphere cannot be without its influence, yet it is, we believe, the universal opinion of magneticians that this change cannot account, either in magnitude or law, for the somewhat considerable daily variation. The diurnal change produced by the sun's heat in the magnetic condition of the crust of the earth must be still more insignificant, and may be at once dismissed.

Our attention is thus concentrated on the third and fourth of the above possible causes, one of which we may perhaps expect to account for the daily variation, unless this be due to some cause of the nature of which we are entirely ignorant.

It is now well known that what are called earth-currents are of very frequent, if not continuous occurrence, and we are indebted to the present Astronomer Royal for an experiment made with the view of ascertaining the nature of the relation between these currents and the changes of terrestrial magnetism. He set up certain wires on the Croydon and Dartford lines, which gave him, by means of a self-recording arrangement, a continuous record of the strength and duration of these earth-currents, and the following is the conclusion which he has derived from the discussion of these observations:—

"Neither in magnitude nor in law are these inequalities consequent on the galvanic currents competent to explain the ordinary diurnal inequalities of magnetism."

In fact, there is some reason to regard these currents rather as the *effects* than as the *causes* of magnetic changes, that is to say, to view them as secondary currents; and the author of this notice has shown in a paper, published in the Transactions of the Royal Society of Edinburgh, that these earth-currents are strongest at those periods of the day when the change in terrestrial magnetism is most rapid—a result which would follow if the earth-currents were secondary currents due to magnetic changes. Our attention is thus drawn to the fourth hypothesis as the only remaining conceivable cause of magnetic changes, unless these are caused by something of which we are entirely ignorant.

It is known that Faraday tried to detect induction currents in the Thames, supposing that these might be caused by the carriage of a conducting liquid across the earth's lines of magnetic force, but found no positive result. Sir W. Thomson afterwards made a proposal to test the idea by tides in the English Channel, but we do not think this has ever been carried out. He also discussed to some extent the part which may be played in the phenomena of terrestrial magnetism by moving conductors.

But to return to the fourth hypothesis. In the first place, let us ask ourselves the question, Under what circumstances can the convection currents generated by the sun's heat become conductors? Now, this can only take place in the upper and rarer regions of the atmosphere, since dense air is manifestly a non-conductor. We have therefore in the upper regions of the air a conductor—rare air—conveyed across the earth's lines of force by the convection due to the sun's heat, probably with a very considerable velocity. Now, is it not possible that these moving conductors may have currents generated in them which will act upon the magnet both directly and through the earth? As far as we are aware no attempt has yet been made to treat the question mathematically; indeed, we are hardly prepared for that at present, since we know very little about the convection currents in the upper regions of the earth's atmosphere.

We may perhaps, however, deduce the laws of the upper convection currents from what we know of the lower currents. Now, there are several points of similarity between the convection currents as we know them and the daily magnetic variations. The *first* in order is that noticed by Mr. Baxendell, who observed a very strong likeness between the daily behaviour of the wind and that of the magnetic declination.

The *next* is a resemblance between what we know takes place near the equator as regards the magnetic declination and what we imagine must take place as regards the upper convection currents. Sir E. Sabine has shown that near the equator the diurnal magnetic change is of an opposite character during the two halves of the year reckoning from the equinoxes, so that it is only at or near the equinoxes that the diurnal inequality might be expected to vanish as it passes from the one phase to the other. Now, we should quite expect something of this kind if the diurnal changes were due to convection currents; and just as the change which we might expect in the convection currents of these regions on account of the motion of the sun in declination would probably not be gradual, but of a hesitating or oscillatory character, so Mr. J. Allan Broun has found from his magnetic observations at Trevandrum (page 180 of Dr. Lloyd's work) that the magnetic change is not a gradual or regular one. This is a very important remark, and if followed up by a thorough discussion of the various tropical magnetic observations, may be expected to throw much light on the cause of the daily variation.

The third point we would notice is a peculiarity in the behaviour of the daily magnetic variation near the magnetic pole.

> "The observations of Sir Leopold M'Clintock in 1858—59, at Port Kennedy," says Dr. Lloyd, "have enabled Sir Edward Sabine to throw further light upon the laws of the diurnal variations. The declination at Port Kennedy is N. 136° W.; while that of Point Barrow is N. 41° E. The north poles of the needles at the two stations, which are at opposite sides of the earth's magnetic pole, thus point in opposite directions. Now, when disturbances are removed, the observations gave the greatest deflections at 8 A.M. and 2 P.M., as in other places. But they showed, further, that the positions were referred in both to the *magnetic meridian* of the place, and not to the *astronomical*; the deviations of the magnet at 2 P.M., for example, being in both places *to the left* of an observer looking towards the magnetic pole at each place, and therefore *geographically* in opposite directions."

Now, meteorologically, the north magnetic pole is not far from the pole of greatest cold, and we might, perhaps, expect on opposite sides of the pole to find the upper convection currents going in opposite directions. If this be the case, and if the daily variation be due to those currents, then we might also expect a magnetic behaviour such as was deduced by Sir E. Sabine from the observations of Sir L. M'Clintock.

We think, in fine, that the behaviour of the daily variation at the tropics, at middle latitudes, and near the magnetic pole, is not inconsistent with the hypothesis that such variation is due to convection currents. But if this hypothesis be true, it cannot be limited to the daily variation. We know very well that the currents of the earth's atmosphere often present great irregularities, and that these irregularities are especially prevalent at the equinoxes. Now, we have a precisely similar peculiarity in magnetic changes. These are frequently irregular, and their irregularities are greatest at the equinoxes. In proof of this we extract the following table from Dr. Lloyd's work:—

Annual variation of the mean disturbance at Dublin.

Month.	Mean Disturbance.	Month.	Mean Disturbance.
January	0·48	July	0·57
February	0·57	August	0·56
March	0·58	September	0·67
April	0·57	October	0·66
May	0·52	November	0·59
June	0·48	December	0·45

The next point to which we would allude is a similarity between the secular variation of the meteorology and magnetism of the earth. Mr. Baxendell, we think, was the first to point out that there is a change in the convection currents of the earth, depending on the state of the sun's surface with regard to spots; and Mr. Charles Meldrum has followed with the very interesting and important announcement that we have most frequent cyclones in the Indian Ocean during years of maximum sun-spots; and finally, M. Poey has shown that there is a similar correspondence between sun-spots and the hurricanes of the West Indies. In fine, we have here an intimate connection between solar and terrestrial meteorology. But we have also a connection between sun-spots and magnetic disturbances; and Sir E. Sabine was the first to point out that during the years of greatest sun-spots we have the greatest disturbance of terrestrial magnetism. Now, may not the increase of magnetic disturbance be due to the increase of meteorological disturbance which the sun somehow produces, the upper convection currents influencing the magnet in the manner above stated?

It is probable, however, that some will raise the following objection to this hypothesis. When there is a great magnetic storm or disturbance, this takes place simultaneously and abruptly throughout the whole earth; now, how can this be the result of a meteorological commotion?

We would reply to this objection that magneticians have begun to recognise two sets of disturbances.

When the writer of this notice was at the Kew Observatory, this was forcibly brought before him. There are disturbances of a rounded character, and there are others which are exceedingly abrupt; and we think that Senhor Capello has shown that these rounded disturbances are certainly not simultaneous between Kew and Lisbon. The abrupt disturbances constituting magnetic storms are, however, probably simultaneous all over the world. It is thus possible to imagine the former or rounded disturbances to be caused by convection currents, but it is quite impossible to regard the latter as so caused. How, then, can these be accounted for consistently with this hypothesis? We reply, that when there is a considerable disturbance in the convection currents of the earth, these currents, as we have explained, conveying electricity, we may then expect such currents to influence and alter the magnetism of the earth. The earth gets out of relation as a magnet to these currents, and rights itself abruptly; and this abrupt change of the earth occurring simultaneously all over it, may form the second kind of magnetic storm.

Corresponding to these two varieties of magnetic disturbances, we have, in all probability, two kinds of auroras.

The upper convection currents of the earth, if they convey electric currents, may probably be self-luminous, and this may account for auroras of a local nature, and perhaps also for the nearly perennial displays of auroras near the magnetic pole.

On the other hand, whenever we have an abrupt magnetic storm we have the production of secondary currents due to the small but abrupt changes taking place in the magnetism of the earth, and these secondary currents will manifest themselves both in the upper strata of the earth's crust, which are conductors, and in the upper strata of the earth's atmosphere, which are also conductors. In the former case they will produce violent earth-currents; in the latter they will produce a magnificent auroral display, cosmical rather than local in its characteristics.

We have already alluded to the Greenwich self-recording instruments for registering earth-currents, and the author of this notice has inspected several of the curves given by the Greenwich instruments during violent magnetic storms. The characteristic of these traces is an abrupt and violent change from positive to negative and from negative to positive. Now, this is a behaviour quite in accordance with the hypothesis that these are secondary currents due to magnetic changes, but quite inconsistent with the hypothesis that they are themselves the causes of such changes.

Altogether, we would venture to conclude, *firstly*, that if the changes of terrestrial magnetism are not due to some such cause as that which we have stated, then they must be due to some cause of which we are entirely ignorant; and, *secondly*, that the laws of the magnetic changes are, in all the points we have examined, consistent with the idea that they are due to the carriage of conductors across the earth's lines of force.

B. STEWART

SIMON'S "SPIDERS OF FRANCE"

Les Arachnides de France. Par Eugène Simon, Vice-Président de la Société Entomologique de France. Tome premier. (Paris, 1874.)

EXCEPTING two or three, either partial or abortive, attempts at the early part of the present century, by Baron Walckenaer, no effort has, until now, been made to supply a history of the spiders indigenous to France. This is the more remarkable, inasmuch as, though Arachnology has but few votaries in any country, yet England, Sweden, Prussia, and even Italy, have furnished more or less complete works on their respective spider-faunas. Looking again at the geographical position of France, perhaps few other equal areas would give such a promise of rich results to the araneologist; with all the advantages of an insular position, France combines those of the general Continent of Europe; and her climate ranges from the sub-arctic, in her mountain regions, to the semi-tropical on the Mediterranean shores. We may confidently, therefore, expect a vast addition to our knowledge of European spiders from the labours of the industrious author who has stepped into the breach, and whose first volume on the Spiders of France stands at the head of this notice.

As its title implies, the work is intended to embrace more than the one order (Araneidea) of Arachnids; certainly (it is understood) the orders Scorpionidea and Phalangidea; but whether it will extend also to the other orders, is yet undecided. The present volume, pp. 1-269, Pl. i. ii. iii., embraces five families of the order Araneidea (or Araneæ). It is a matter of regret that it had not been practicable to retain a systematic sequence in regard to the details of the order; the reason given for this is that the author has taken first those families of which he was in possession of the amplest materials; another drawback also seems to be, that the Introduction, "comprising general remarks on the class Arachnida and its bibliography," will not appear until later; when it will, however, be specially paged for addition to the first volume. The volume before us begins with a useful glossary of special terms used in the descriptions; to this follow (pp. 5-15) some general remarks on the characters of the order ARANEÆ, and some criticisms on the more extended works of different authors upon it; concluding with the outlines of the classification adopted in the present work. In regard to classification but little alteration is proposed from that contained in a paper, "Aranéides nouveaux ou peu connus du Midi de l'Europe, 2e mémoire," by the author,* published (according to the title-page of its author's presentation copies) in 1873, in "Mémoires de la Société Royale des Sciences de Liége."

For the principles of M. Simon's primary divisions of the Araneidea we are referred to the second memoir above mentioned; there, after giving his reasons for dissenting from the primary divisions adopted by Dr. Thorell in his work "On European Spiders," the author divides the Araneidea into four sub-orders: 1. THERAPHOSÆ; 2. GNAPHOSÆ; 3. ARANEÆ; 4. OCULATÆ. The sequence of these is reversed in the volume before us; the name of the third is changed to *Araneæ veræ*, and of the fourth to *Araneæ oculatæ*. The addition to the name of the third order was necessitated by the adoption of the term Araneæ

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* This paper does not, however, appear yet to have been "published" in the only true acceptation of the term; that is, *offered to the public for sale*; and, it is understood, will not be so published until 1875. This is in some respects a matter of importance, inasmuch as the claim of many species and some genera to the names under which they are, or will be, characterised in the present work, rests for their priority upon the date of publication of the above paper in the Mém. Liége. Similar remarks apply to the 1e Mémoire on "Aranéides du Midi de l'Europe," the presentation copies of which were issued in 1870, while the volume containing it was not published until 1873.

(Sundevall) as the name of the whole order, in lieu of Araneidea—Aranéides. With regard to this change, it has the opinion and authority of Dr. Thorell in its favour; and something may be said for it on its own merits; but still, similar terminations (such as in the present instance the ordinal termination -eidea, in the class Arachnida), when adopted for the designation of parallel groups in nature, are of considerable use in fixing the necessary framework of classification in the mind. The grouping, however, of the different families in M. Simon's four sub-orders will, we may anticipate, hardly find much favour among araneologists. The "Araneæ veræ" form an exceedingly heterogeneous group, including as it does spiders so widely separated as the Thomisides and Pholcides! The "Gnaphosæ," also, consisting only of the Dysderides and Scytodides, comprise two very distinct groups, with little in common except the number of the eyes, and the mode of adaptation of the palpal organs to the digital joints of the male palpi; characters found also among the "Araneæ veræ," as well as among the "Theraphosæ."

With respect to the distinguishing characters given of the sub-orders "Araneæ veræ" and "Araneæ oculatæ" (*Yeux diurnes* and *Yeux nocturnes*)—the former coloured and convex, the latter vitreous and flattened—some detailed proof of these differences producing the results asserted would seem to be necessary. Differences, indeed, there are between the eyes of various spiders: some are undoubtedly flattened, some misshapen, and, as in the genus *Œcobius*, apparently more or less aborted; some also are of a pearly-white lustre, some dark, and others brilliantly coloured; but that the eyes of spiders may be distinguished as nocturnal or diurnal by the presence or absence of colour, is an idea at least opposed to the views of an eminent insect anatomist, M. F. Müller, who, as long ago as 1826, "Zur Vergleichenden Physiologie des Gesichtssinnes," wrote against M. Marcel de Serres in regard to a similar point among insects. Apart, however, from this point, it would seem scarcely necessary to attempt the very difficult task of dividing into sub-orders a group so homogeneous as the order Araneidea.

The linear arrangement of the families adopted by M. Simon is very natural, and the interpolated names of his Sub-orders appear to be of little assistance as mere divisional marks, while their scientific tenability seems also, as hinted above, very questionable. M. Simon, while attributing confusion of mind to Dr. Thorell (Note 1 to p. 10) in regard to his notions respecting Orders and Families, appears to have himself fallen into some confusion in regard to the difference between Orders and Sub-orders; in the note above quoted these two kinds of groups are spoken of as though of equal significance in classification, and as being similarly characterised. An Order, however (characterised by complications of structure common to all the families of which it is composed), limits a group within a CLASS; while the Sub-order limits a group within the Order; a group distinguished differentially from the Order by some special complications of structure peculiar to itself. Each of M. Simon's four Sub-orders should, consistently with his definition of those groups, be based "Sur un caractére anatomique profond, indépendant de la forme, mais indiquant une supériorité ou une infériorité dans les limités de la classe." When we turn, however, to the characters given (in the Mémoire before quoted), we find some considerable details given under each of the Sub-orders; but the special anatomical character indicating the superiority or inferiority of each is not apparent. If the difference between *Yeux diurnes* and *nocturnes* be the character intended, no mention is made of it in respect to the Theraphosæ, while the *Araneæ veræ* possess eyes of both kinds, "the two central eyes of the first row are diurnal, the other six nocturnal." And even supposing these characters to be good and constant, it is not easy to see what superiority or inferiority is indicated by them. All recent investigation tends to lessen the value of characters taken merely from the eyes of spiders, for higher divisional purposes. Supposing they are so, all we could say is, that they are modified and adapted to the habits of the different spiders, and are thus, at most, valuable for *specific* determinations.

Passing on to the body of the work, we find good terse descriptions of 131 species of spiders distributed among the six families—Epëiridæ, Uloboridæ, Dictynidæ, Enyoidæ, and Pholcidæ; the genera comprised in these being twenty-three in number. The genus *Epëira* absorbs thirty-nine out of the seventy-four species contained in the whole family EPËIRIDÆ, the remainder being distributed as follows:—*Peltosoma*, 2; *Argiope*, 2; *Cyrtophora*, 1; *Cyclosa*, 5; *Larinia*, 2; *Singa*, 8; *Cercidia*, 1; *Zilla*, 6; *Meta*, 3; *Tetragnatha*, 5. In the family ULOBORIDÆ are four species distributed between two genera: *Uloborus*, 3; *Hyptiotes*, 1. The family DICTYNIDÆ contains thirty-six species, distributed among four genera: *Dictyna*, 14; *Lethia*, 5; *Titanœca*, 7; *Amaurobius*, 10. The family ENYOIDÆ comprises three genera and eleven species: *Ceto* (gen. nov.), 1; *Selamia*, 1; *Enyo*, 9; while the last of the families contained in the present volume, PHOLCIDÆ, has three genera and five species: *Holocnemus*, 1; *Pholcus*, 2; *Spermophora*, 2.

The above families are characterised at considerable length, and the diagnoses of genera are terse and good. An analytical table, with cross references of the chief characters of all the families intended to be included in the work, is given at page 14; similar tables are also given of the genera and species; of some of the genera, separate tables of the males and females are given.

Of the twenty-three genera contained in this first volume, two—*Larinia* and *Ceto*, in the family Enyoidæ—are characterised as new. The species described as new are sixteen in number: six in the family Epëiridæ, genera *Larinia*, *Epëira*, and *Tetragnatha*; eight of Dictynidæ, in the genera *Dictyna*, *Lethia*, *Titanœca*, and *Amaurobius*; and two of Enyoidæ, in the genus *Enyo*. The semi-tropical character of the present portion of the spiders of France may be noted in the genera *Peltosoma*, *Argiope*, *Cyrtophora*, *Ceto*, *Selamia*, *Enyo*, *Holocnemus*, and *Spermophora*.

The plates illustrating this volume—three in number—are engraved on copper, and reflect great credit on both the artist (M. Simon himself) and the engraver. The figures, not too small, are yet remarkably clear, and all the minute points of form, structure, and pattern, are exceedingly well defined. One only regrets that the number of species illustrated should be, perhaps necessarily, so limited; a type only of each genus being represented, with some few structural details of others. Figures, such as those here given, of all the species comprised in the work, would make it one of the most valuable and important faunistic works on spiders that have been published for many years. In spite, however, of this, probably inevitable, drawback, we hail this volume with great satisfaction, not only for what it is in itself, but as an earnest of what we hope is to follow before any great lapse of time. A second volume, containing four more families—Urocteoidæ, Agelenidæ, Thomisidæ, and Sparassidæ—is announced for April next; and it is considered that four or five volumes in the whole will complete the work.

ANTHROPOLOGICAL NOTES AND QUERIES

Notes and Queries on Anthropology, for the Use of Travellers and Residents in Uncivilised Lands. Published by a Committee appointed by the British Association for the Advancement of Science. (London: E. Stanford, 1874.)

WELL asked is half answered, and more problems escape solution because no one happens to propose them, than because of their real difficulty. To suggest suitable inquiries to the mind of a traveller or colonist as to the wild races he comes in contact with, is to start him on a course of ethnological investigation which may lead to excellent results. The plan of drawing up lists of such inquiries to be distributed among naval officers, missionaries, and others, is not new. The Ethnological Society of London issued a set years ago, which drew much information. An elaborate series of questions as to the North American tribes, answers to which constitute some of the best material in Schoolcraft's "Indian Tribes of the United States," is reprinted at the end of vol. i. of that work. The "Admiralty Manual of Scientific Inquiry" contains an ethnological section, first drawn up by Dr. Prichard, and since revised. The present publication issued by the British Association is far more complete than any of these earlier guides. The committee by whom it has been drawn up are Col. Lane Fox (secretary) Dr. Beddoe, Mr. Franks, Mr. F. Galton, Mr. E. W. Brabrook, Sir J. Lubbock, Sir Walter Elliot, Mr. Clements R. Markham, and Mr. E. B. Tylor. The first sections, relating to the physical constitution of man, are drawn up by Dr. Beddoe, who gives drawings and directions for measurement of skull and limbs, &c. It adds much to the value of the book that the eminent French anthropologist, Dr. Broca, has allowed his set of colour-types to be reproduced. By the aid of these tinted patches, the colour of skin, hair, and eyes in individuals of any race may be set down within a shade. Thus, instead of loosely describing a Peruvian Indian's complexion as copper-brown, it might be defined as between No. 42 and No. 43 of Broca's table. The section on archæology is by Col. Lane Fox, and contains cuts of the principal types of stone implements, contributed by Mr. John Evans, also an ideal representation of a valley, to show the position of the gravel beds above the present river-level, where travellers may be likely to find drift-implements. The sections on war, hunting, and ornamentation are also by Col. Fox; the latter article is especially interesting from the illustrations of the principal patterns used in barbaric ornamental carving, &c., such as the chevron, fret or key-border, plait or guilloche. Mr. Franks deals with the subjects of clothing, personal ornaments, pottery, &c.; Mr. Evans with weaving, basket-work, &c.; Mr. Galton with statistics; Sir J. Lubbock with relationships; Mr. Tylor with religion, mythology, language, customs, &c.; Prof. Busk with artificial deformations; Prof. Carl Engel (whom the printer has converted into *Cave* Engel) on music; Mr. Hyde Clarke on weights and measures, money, &c. The articles often contain not only leading questions, but introductions which state in few words what is known on their subjects.

We strongly recommend those who have friends within reach of uncivilised countries to send them out at once copies of this little manual. Being not a regular trade publication, but issued by a scientific body, it may very likely fall out of print when the first stock is exhausted.

OUR BOOK SHELF

Lessons in Elementary Botany. New Edition. By D. Oliver, F.L.S., F.R.S. (Macmillan and Co., 1874.)

THE new edition of this admirable little text-book deserves a word of notice. It is slightly enlarged, the additions principally dealing with the most important points in economic botany. The illustrations have been increased in number, and the few small errors which had crept into the first edition have been corrected. In the present state of our classificatory knowledge of flowering plants, it would be hardly possible to have a better guide than Prof. Oliver's "Lessons." Something, doubtless, will still have to be supplied by the oral instruction of the teacher. No series of natural objects ever was or ever will be quite comfortable when packed into a classification. The exposition of the term *perigynous*, for instance, requires that the pupils should be not exacting, but reasonable; there have been found even grown-up and advanced botanists who have allowed themselves to be sceptical about the application of the term to the corolla of the common Holly. They have even ventured to go so far as to wonder how the insertion of the corolla would differ in this case if it were *hypogynous*.

The few pages at the end of the book devoted to Cryptogams have been slightly enlarged, but are still not perhaps intended to more than indicate the existence of other types of vegetable life besides Phanerogams. If the criticism may be allowed (and it really seems ungracious in a case like the present), it would have been better not to apply the term Order to groups differing so widely in their relative diversity as, say, *Cyperaceæ* and *Gramineæ* on the one hand, and *Musci* and *Fungi* on the other. On no possible modern classificatory principles can such aggregates of organisms be regarded as equipollent or comparable. Then *Lichenes* can hardly be said to hold up its head as a distinct group with the same unimpeachableness that was the case five years ago.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

On the Northern Range of the Fallow Deer in Europe

THE essay, illustrated by woodcuts, on the existence of the Fallow Deer in Pleistocene times in England, in NATURE (vol. xi. p. 210), leaves no room for doubting that the antlers named in the books *Cervus brownii* and *Cervus somonensis*, really belong to a variety of the living Fallow Deer. And I thank its author, Sir Victor Brooke, for having brought forward evidence on the point which is not presented by any of the large series of recent antlers known to me in the British and Continental Museums, and without which I could not venture to identify the fossil with the living form. He has supplied the missing link hitherto sought in vain, and thereby removed two synonyms from the bulky catalogue of fossil mammalia. This identification, however, as I have already remarked in NATURE (vol. xi., pp. 113, 114), has little, if anything, to do with the further question, raised by Drs. Jeitteles and Sclater, as to whether the Fallow Deer now living in Northern and Central Europe was introduced—like the horse into South America—by the hand of man; and on this point I am glad to find my views shared by so high an authority on the Cervidæ as Sir Victor Brooke.

W. BOYD DAWKINS

Owens College, Jan. 16

The Habits of the Belted Kingfisher (*Ceryle alcyon*)

IN NATURE, vol. vii. p. 362, I made the assertion that I had "never seen a kingfisher take its food otherwise than by swallowing it whole, while yet upon the wing," and therefore questioned the truth of the remark made by Mr. Darwin, that kingfishers, having caught a fish, "always beat it until it is killed." The truth of my assertion was doubted by many, and being assured by careful observers that Mr. Darwin's remark did apply to our species, I determined to very carefully study the habits of the bird in question, and have taken every opportunity possible, during the past two years, to familiarise myself with the daily routine of its life. The following is the result:—In 1873 my opportunities were exceptionally good for observing the movements of a pair of these birds, inasmuch as the whole season through—from April to November—was spent upon the water, studying our freshwater fishes. My daily record of observations mentions my watching the kingfisher *while feeding*, from one to four times a day for eighty-three days—an average of twice a day, or 166 dives for fishes, witnessed; and either every plunge was unsuccessful, or the bird swallowed, before alighting, every fish he had taken. It is to be presumed, of course, that occasionally the bird missed his prey. At the close of the season, therefore, I felt satisfied that I was correct in my assertions; but, as one of our best ornithologists has said, "the horizon of one man is at the best very limited, and many ornithological facts occur that are not dreamed of in his philosophy;" and so, on mentioning the results of my seven months of observation to a careful observer of our birds, and finding that he sided with Mr. Darwin, I determined to repeat my observations, and have done so through the spring, summer, and early autumn of the present year. My opportunities were equally good, and, very much to my own satisfaction, I have a different result to give. It is proper to state here, that during the summer of 1873 my observations were made altogether in one locality, upon one stream—the summit level of a canal—and confined to one pair of birds. During the present year I watched the kingfishers in several widely differing localities. My note books make mention of this bird from two to six times in a day, for 101 days—about 400 observations; and of this series, eighty-eight instances are recorded of seeing the kingfisher capture, and, on alighting, deliberately beating the fish against the limb on which he stood, and then swallowing the *butchered* fish. This is a long way from being a constant habit of the kingfisher; less than one-fourth of the fish taken being killed previously to being swallowed. There is, of course, some cause for both habits occurring, and I believe it is to be explained in this way:—

As already stated, my observations during 1873 were confined to one pair of kingfishers, and to the one locality they frequented—the summit level of the Delaware and Raritan Canal—and the obvious reason of the kingfishers always swallowing their prey as soon as caught was simply that they fed exclusively on the smaller cyprinoids frequenting that sheet of water. I know, of my own fishing experience (pursued after a different manner from the kingfishers, however), that millions of cyprinoids are found there, as though they sought there an asylum from the attacks of predatory fishes.

During the season just past, I took notes on such kingfishers as were seen about two creeks, a mill-pond, and the Delaware River. In each of these localities large fishes of many kinds are more or less abundant, and the percentage of small cyprinoids—from two-and-a-half to three inches long—being much less than in the canal, it would evidently be irksome to so voracious a bird as the kingfisher to wait until some fish, the proper size for swallowing without preliminary butchering, should come within reach.

It therefore seems to depend largely upon the size of the captured fish, whether or not it is killed by the kingfisher before being swallowed.

On examination of my note-books I find also that when the parent birds had young in the nest, or while the hen-bird was upon her eggs, the male bird was most frequently seen to carry a fish in his beak to some convenient perch, and there kill and divide it. This appeared to be the manner of proceeding when the parent bird purposed feeding its mate or the young; being able, I judge, to disgorge a fragment of a larger fish, but not to eject an entire fish.

Both habits having been found to be true of this bird—that of swallowing the fish when caught, and of killing it before eating it—it is desirable to know why the latter method should be the rule, almost without exception, in some localities. I can only suggest that this may depend upon the anatomical characteristics of the fishes caught by the kingfishers. When an abundance of cyprinoids—soft-finned fishes—are to be obtained, then little or no preliminary carving on the part of the birds is necessary; but if young acanthopterygians, and tough, hard-scaled fishes of any family, have to be depended upon, then the kingfisher will be careful to first kill and pull in pieces such fishes, that unsuitable portions may be rejected. I have a memorandum of one instance where a young gizzard shad (*Dorosoma cepedianum*) was beheaded and divided into four portions before the kingfisher ate it.

In studying the habits of our American birds—and I suppose it is true of birds everywhere—it must at all times be remembered that there is less stability in the habits of birds than is supposed; and no account of the habits of any one species will exactly detail the various features of its habits as they really are, in every portion of the territory it inhabits.

Trenton, New Jersey, Nov. 20

CHAS. C. ABBOTT

Kirke's Physiology

IN Kirke's "Physiology" (p. 128, 7th edition) mention is made of a conception, due to Mr. Savory, concerning a probable function of the Sinuses of Valsalva, which appears to me to be based on a neglect of an important hydrostatical law. And as this error is not only widely spread, but is considered a point of some importance among students of physiology, it may not perhaps be unwise, even now, to call attention to it. It is stated that, owing to the expansion of the aorta towards its termination, part of the force of the reflux of the column of blood is sustained during diastole by the muscular substance of the ventricle. Now, it seems that a consideration of the law above referred to, which is known as Pascal's "Principle of the Equality of Pressures," must essentially modify this statement. It will be well to note, however, before tracing its application, that notwithstanding the varying mechanical conditions of the column, and the structures in relation with it, these conditions at any one point of time during dilatation may be regarded as fixed and invariable. Also, that as these conditions vary in degree and not in kind, what is true of any one period of time must, in so far as the present demonstration is concerned, be true of any other.

Let us consider the state of things immediately upon the conclusion of the systole. Firstly, the whole arterial system is in a state of distension, and, in virtue of its elasticity, tends to contract and to impel the blood in two directions—onwards through the capillaries, and backwards against the heart. There is also a cessation of the opposing impulsive force from the ventricle, and the combined effect of these two actions is to produce the "force of reflux." And since, as has been shown above, it is unnecessary to trace the variations due to the mobility of the system through the whole period of dilatation, it may be said that at any given instant we have the following data, viz., a column of fluid contained in a vessel with an expanded base, and a certain force impressed upon that column. It is obvious that it cannot affect our conclusions to assume that the force of reflux is transmitted to an imaginary surface, which we can fix at a point immediately above the expansion of the vessel, where it attains its normal calibre, and we can then ascertain how this force is further transmitted to the base. This base is, however, made up of two parts, a circumferential part by the muscular substance of the ventricle, and a central part by the semilunar valves, the whole area being greater than that of any other section of the column. Now, the question at issue is, whether by this arrangement the semilunar valves bear any less pressure because a portion of the base of the column rests upon the wall of the ventricle. That they do not may be sufficiently proved by the following considerations.

It is a generalisation from Pascal's law that "when a liquid enclosed in a vessel is submitted to an external pressure, every plane surface that we can imagine in the interior of the vessel experiences a pressure proportional to its area." As a consequence of this law, it follows, if the force impressed upon our imaginary surface represent the total force of reflux, that the pressure sustained by the whole area of the base will be considerably greater than the actual force of the column, and this increase of pressure will be proportional to the difference between the areas of the two surfaces. Also, the pressure upon the semilunar valves will be entirely independent of the pressure upon the rest of the base, and will be directly proportional to their own extent. It may be concluded, therefore, that whatever the condition of things at the base of the aorta may be, no mechanical advantage is gained thereby; indeed, if the area of the valves be equal to that of the surface we have taken, they will sustain a pressure equal to the total force of reflux of the column. Hence, by extending the area of the base over the wall of the ventricle, the only effect is to increase the total amount of pressure sustained, without at all lessening the pressure upon its original extent.

It is true that if the aortic orifice contract with the muscular substance of the ventricle, that in this way, *i.e.* by decreasing the area of the valves, a varying amount of advantage would be gained which would be greatest at the time of greatest contraction. This condition is, however, the only one that can at all favour the idea that "the reflux is most efficiently sustained by the muscular substance of the ventricle," and as this condition is doubtful, it must still seem that the main feature of Mr. Savory's theory cannot be supported. W. PERCY ASHE

Phœnician Characters in Sumatra

IN a short communication to the Anthropological Institute in December last (NATURE, vol. xi. p. 199), Phœnician characters were stated by me to be still in use in South Sumatra. As many of your readers may be glad to have more information on the subject, I write to say that the district above alluded to includes Rejang, Lemba, and Passammah, between the second and fifth parallels of south latitude. Several manuscripts, on bamboo, from this region are preserved in the library of the India Office; and a Rejang alphabet is given by Marsden in his "History of Sumatra," third edition. Some of his characters, however, appear to have been incorrectly copied. About half the Rejang letters are admitted by all the Oriental scholars to whom I have shown them to be Phœnician of the common type; others being similar to forms found in Spain and other Phœnician colonies. Most of the letters are *reversed*, a peculiarity which is explained by the fact that the Rejang writing, according to Marsden, is read from left to right, contrary to the practice of the Malays generally. The matter is of great interest, and, it is to be hoped, will be investigated by Phœnician scholars.

J. PARK HARRISON

Ring Blackbird

IN my letter in NATURE, vol. xi. p. 187, I did not refer to the Ring Ousel, for it did not occur to me that anyone would suppose that, with the apparatus of so many standard works on birds, I could fail to identify my bird, if he were a Ring Ousel, male or female. I therefore add that my bird is in no respect (save the prevailing colour) like that species of *Turdus*. It is *exactly* like a female blackbird, save that it has a white ruff, in the position of the Barbary Dove's ring, and white spot under the chin. I have never seen a Ring Ousel, or the picture of one, with those characteristics. Besides, the Ring Ousel is migratory, and would hardly be seen till the spring.

Athenæum Club, Jan. 16 C. M. INGLEBY

[Considering the time of year at which this specimen was obtained, it is more probable that it is a pied variety of the blackbird (which is far from uncommon) than a Ring Ousel. If our correspondent will forward the specimen to us, for examination, we will settle the point for him, and return it.—ED.]

OUR ASTRONOMICAL COLUMN

THE TOTAL ECLIPSE OF THE SUN ON APRIL 6.—Dr. Janssen's station for the observation of this eclipse is mentioned as probably Hué, the position of which place, as laid down on the Admiralty Chart of Cochin China, is in longitude 107° 38′ east of Greenwich, and latitude 16° 29′ north. For this point the *Nautical Almanac* elements give the following figures:—

First contact at 1h. 38m. 6, local mean time, 130° from the sun's N. point towards the west, for direct image. Totality begins at 2h. 57m. 2s., and continues 3m. 12s., the sun at an altitude of 46°.

ENCKE'S COMET will no doubt be within reach as the moon withdraws from the early evening sky. The positions subjoined are reduced to 8h. Greenwich time from the ephemeris of Dr. von Asten, of Pulkova, published by the Academy of Sciences of St. Petersburg:—

		R.A.			N.P.D.		DISTANCE.
		h.	m.	s.	°	′	
1875—Jan.	24	23	23	31	85	40·6	1·989
,,	25	—	24	53	85	32·9	
,,	26	—	26	16	85	25·0	
,,	27	—	27	40	85	17·0	
,,	28	—	29	6	85	8·8	1·977
,,	29	—	30	33	85	0·4	
,,	30	—	32	2	84	51·9	
,,	31	—	33	31	84	43·3	
Feb.	1	—	35	2	84	34·5	1·961
,,	2	—	36	34	84	25·5	
,,	3	—	38	8	81	16·4	
,,	4	—	39	43	84	7·1	
,,	5	23	41	20	83	57·6	1·940

Mr. Otto Struve writes that Dr. von Asten's calculations show the last three revolutions of this comet can be perfectly represented by a uniform mean motion, without the hypothesis of a resisting medium, and even with greater precision than all the previous observed returns with that hypothesis. At the same time, during more than one revolution, something like acceleration has been indicated, and nearly to the same amount as Encke had supposed. This was the case between 1862 and 1865. Again, in other revolutions, as between 1845 and 1848, the acceleration has been subjected to very considerable changes. In the actual state of his researches Dr. von Asten is inclined to conclude that the existence of a resisting medium is not proved by the motion of Encke's comet, and that the observed acceleration in several returns ought to be attributed to the action of other forces; for instance, repulsive power produced by the approach of the comet to the sun, the effect of which might vary considerably, according to the conditions in which the return to perihelion takes place. A short paper by Dr. von Asten on this interesting subject is in the press.

WINNECKE'S COMET OF SHORT PERIOD, last visible in 1869, will also be observable in the morning sky from about the next new moon. The ephemeris calculated by Prof. Oppölzer of Vienna will be found in No. 2,016 of the *Astronomische Nachrichten*. This comet will propably be faint, while it remains visible at the present return. It arrives at perihelion on March 12, and at its least distance from the earth on February 15. It is Comet 1819 (3), and Oppölzer thinks he has identified it with one of the imperfectly observed comets in 1808. The elements which have been determined for 1875 show that the comet now makes a very close approach to the orbit of Jupiter; indeed, in heliocentric longitude 109° 25′, the distance between the two orbits is less than 0·06 of the earth's mean distance from the sun; this point is passed rather less than two years before perihelion passage. So far as can be judged at present, the comet will not be liable to great perturbation from the attraction of Jupiter till the year 1907, when it is possible a complete change of elements may take place; this, however, of course depends upon the amount of change which the actual mean motion may undergo, from the successive smaller perturbations of the next thirty years.

Borrelly's Comet of December 6.—Thus far it does not appear that any orbit of the last comet discovered at Marseilles has been published. The following elements, founded on observations between Dec. 7 and 26, received from M. Stephan, Director of that Observatory, may therefore possess some interest:—Perihelion passage, Oct. 19, 1874, at 4h. 36m. Greenwich time; ascending node, 282° 12′ 49″; distance of perihelion from node, counted on the orbit in the direction of motion, 15° 23′ 34″; inclination, 80° 56′ 28″; distance in perihelion, 0·49665; motion, retrograde. These elements bear no close resemblance to those of any previously computed comet.

ON A PROBABLE CAUSE OF THE CHANGE OF THE COURSE OF THE AMÚ DARYA FROM THE CASPIAN TO THE ARAL[*]

If the central regions of Asia are really, as is surmised, the localities where the youth of the human race was passed, agriculture, aided by irrigation, has probably been practised from the earliest ages on the banks of the Oxus.

The description, in Herodotus, of the plain in Asia through which a mighty river called Aces ran and watered the lands of five nations inhabiting its banks, may possibly not apply to the Oxus valley, though the Chorasmians are specified as one of the five nations. But the passage clearly describes the distribution of the waters of the Aces for the purposes of cultivation, and it may with reason be inferred that the art of irrigation was in vogue in the Kharesmian oasis some two thousand years ago. However this may be, the Chinese traveller Hiouen-thsang speaks of Khiva, in the seventh century of our era, as forming but a narrow band on both banks of the Oxus; a description which does not admit of a doubt that the waters of the river were then employed in watering the land.

At the present day the Khanate of Khiva, as is well known, owes its fertility to the numerous canals of irrigation derived from the Amú, between Pitnak and Nukus. The heads of these artificial canals are kept open during the part of the year included between the months of May and November, and thus allow the summer or flood waters of the river, which pass into them, to be distributed over the land of the Khanate. As the volumes and velocities of the streams entering the several canals are less than that of the flood of the Amú, a deposition of silt, carried in suspension by the waters, takes place in these canals. For this, among other reasons, their heads are closed during the winter and early spring months, so as to allow of their running dry, and the deposited silt being then cleared, by manual labour, from their beds.

I am not aware that even a rough estimate has ever been made of the quantity of water thus diverted from the Amú, and passing into these canals, during the period of the yearly floods. It is clear, however, that the physical phenomena of the river must be sensibly affected by the abstraction of so large a body of water from its stream, and I will, therefore, make some attempt to arrive at an approximation to the truth on this head, though the data at my disposition are insufficient, and the conditions of the problem are such as render it difficult to attain to any great precision.

The land under cultivation in the Khanate is generally estimated at about two millions of acres; if we assume that the whole of this cultivation requires the constant use of water, about 40,000 cubic feet per second must be taken by the several canals from the river. It is perhaps true that many of the crops do not require more than partial irrigation, but, on the other hand, the population of about 400,000 souls, and the cattle of the Khanate, are entirely dependent on the river for their water supply. The excess, therefore, assigned for irrigation may be considered as absorbed by the people and by the cattle, and the estimate of 40,000 cubic feet per second may be allowed to stand for the present.

A very rough calculation, founded on the scanty data to be found in General Ivanien's pamphlet on Khiva, and made by me some four months ago, gave 30,000 cubic feet per second as the quantity of water diverted from the Amú by the irrigation canals. It is to be remarked, however, that the few dimensions given of these canals are merely founded on hearsay evidence, and are not the result of actual careful observation, and they refer, moreover, to the state of things which existed forty years ago. No correct estimate can be expected to be deduced from such confessedly general and incomplete information. It results, then, that the first estimate of 40,000 cubic feet per second, founded on the known necessities of the land and its population, is probably nearer the truth than the second, which I derived from a perusal of General Ivanien's interesting pamphlet.

It has already been said that the heads of the canals remain open during the flood season of the Amú; the quantity of water, consequently, entering the canals, depends upon the height of the summer floods of the river, and will be greater as the level of the flood is higher, and will be less as that level is lower. But since a supply of about 40,000 cubic feet per second is a matter of actual necessity to the lives of the population of the Khanate, it is clear that the levels of the canal beds, at their heads, must be so adjusted as to provide for the entry of 40,000 cubic feet per second, even should the level of the Amú flood be an exceptionally low one. It results, therefore, that in all years, except that of an exceptionally low flood, a much greater quantity of water than what is actually required for irrigation and for consumption by the population and by the cattle is diverted from the Amú, and passes by the irrigation canals of Khiva. Ivanien mentions that the excess of water passing by the canals during high floods is allowed to flow into lakes and into the Doudon, Kunya Daryalik, and other old dry beds of the Amú, which thus act as safety-valves to the embankments and works belonging to the irrigated tract. The conclusion which may be drawn from the foregoing is, that in most years there is a very great waste of water arising from the imperfect system of irrigation employed in Khiva. It is needless to enlarge on the magnitude of such an evil in a locality where water is an absolute necessity to prevent the advance of the surrounding desert. With a scientific system of irrigation, it is probable that an acreage of land equal to that at present cultivated on the banks of the Amú might be reclaimed from the desert, by precisely the same expenditure of water which now takes place.

The following table, which I have ventured to compile from the measurements and observations of the Amú Darya made by the officers of the expedition sent in 1874, under the auspices of the Imperial Russian Geographical Society, will enable some idea to be formed of the waste of water which took place on several dates between the 23rd of June and the 10th of September of the year in question. The table shows, in cubic feet per second, the total discharge of the river, the portion of that discharge diverted by the irrigation canals, and the remainder which passed Nukus. I must, however, remark that the quantities shown should be regarded as an approximation only to the truth.

Date New Style.	Volume of River.	Volume passing Nukus.	Volume entering Canals.
23rd June ..	101,000	47,800	53,200
29th " ...	97,900	46,300	51,600
11th July ...	139,800	66,200	73,600
17th " ...	122,600	58,000	64,600
3rd August ..	142,800	67,600	75,200
15th " ...	120,700	57,200	63,500
25th " ..	106,000	50,200	55,800
10th September...	93,100	44,100	49,000
Average per diem	122,200	59,600	62,600

These figures show that in lieu of 40,000 cubic feet per second, which is the water supply estimated to be sufficient for the wants of the Khanate, the irrigation canals, between the 23rd of June and the 10th of September, 1874, diverted, on an average, 62,600 cubic feet per second from the Amú Darya, or ten-nineteenths of the whole volume of the river.

Information does not yet exist which would allow more than a guess to be made of the volume of the low-water discharge of the Amú, but from what has been already stated, it follows that at Nukus there is a very much less difference between the volumes of the summer and winter discharges than there would be if the river were in a state of nature, and if a large portion of its flood-water were not diverted by man for the purposes of irrigation. This equalisation between the summer and winter discharges of the Amú, below the irrigated tract, has great significance, and has suggested to me a cause which may probably account for the change in the course of the river from the Caspian to the Aral. It is a matter of notoriety that the waters of the Amú carry in suspension an enormous quantity of mud and sand, and it is to the deposition, in its old bed, of this suspended matter, that I am inclined to think the change in the course of the river may with much probability be ascribed.

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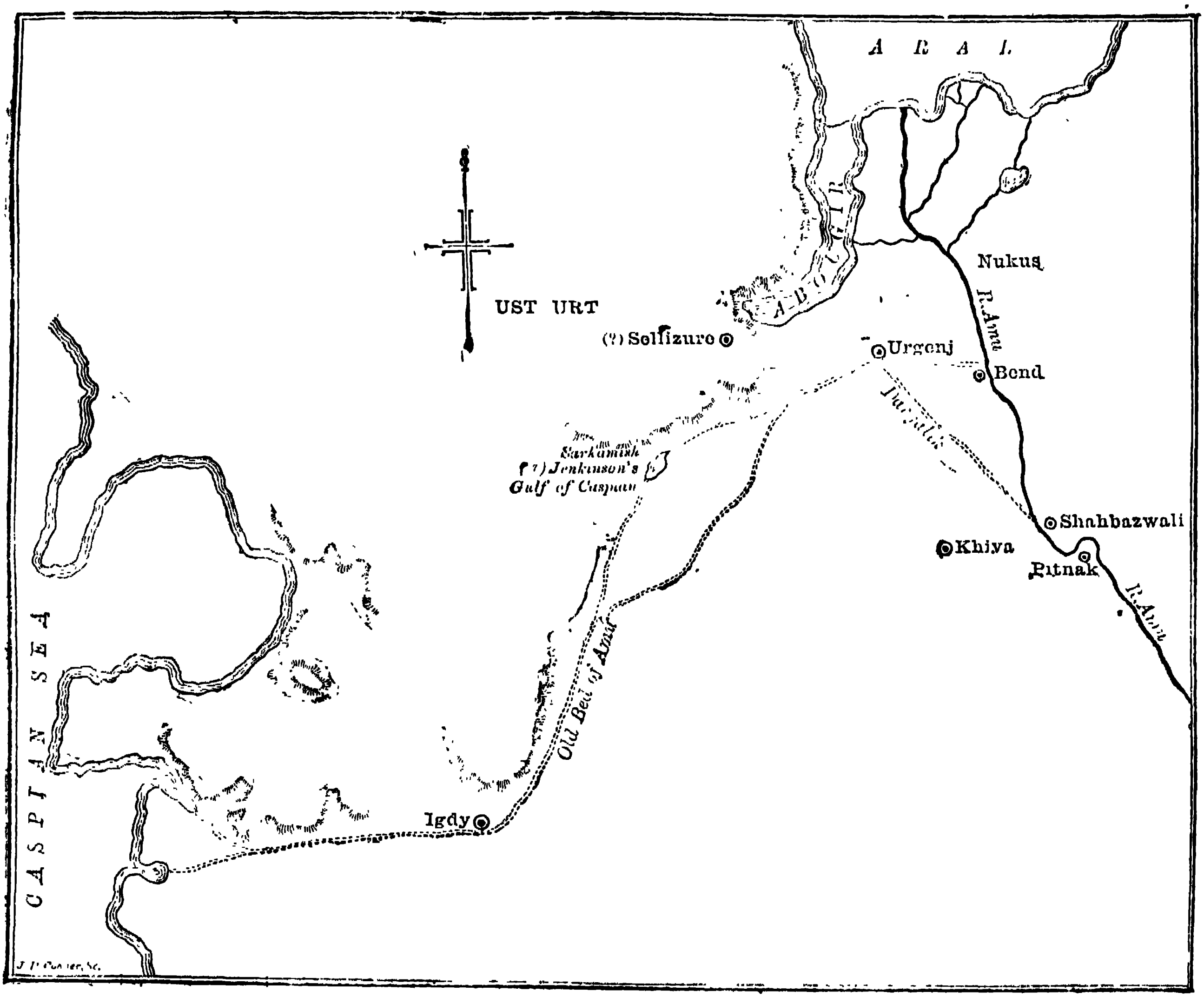
[*] Presented to the Imperial Geographical Society of Russia, December 4, 1874; read at the monthly meeting of the Society, December 16, 1874.

In speaking of the aqueous causes of the changes taking place on the surface of the earth, Sir Charles Lyell, in his "Principles of Geology," has made the following remarks on the transporting power of water. As they cannot be put in plainer and better language, and as they bear intimately on the theory I have hazarded, I will quote them verbatim and *in extenso*:—"The force," he says, "of mountain torrents is easily understood; but a question naturally arises, how the more tranquil rivers of the valleys and plains, flowing on comparatively level ground, can remove the prodigious burden which is discharged into them by their numerous tributaries, and by what means they are enabled to convey the whole mass to the sea. If they had not this removing power, their channels would be annually choked up, and the valleys of the lower country and plains at the base of mountain chains would be continually strewed over with fragments of rock and sterile sand. But this evil is prevented by a general law regulating the conduct of running water: thus, two equal streams do not, when united, occupy a bed of double surface. Nay, the width of the principal river, after the junction of a tributary, sometimes remains the same as before, or is even lessened. The cause of this apparent paradox was long ago explained by the Italian writers, who had studied the confluence of the Po and its feeders in the plains of Lombardy. The addition of a smaller river augments the velocity of the main stream often in the same proportion as it does the quantity of water. The cause of the greater velocity is, firstly, that after the union of two rivers, the water, in place of the friction of four shores, has only that of two to surmount; secondly, because the main body of the stream, being further distant from the banks, flows on with less interruption; and lastly, because a greater quantity of water, moving more swiftly, digs deeper into the river's bed. By this beautiful adjustment the water which drains the interior country is made continually to occupy less room as it approaches the sea, and thus the most valuable part of our continents, the rich deltas and great alluvial plains, are prevented from being constantly under water."



Now, if we apply these principles to the Amú Darya, it is manifest that, when it fell into the Caspian, the conditions of its flow were such that the volume and velocity of its summer or flood-stream were sufficiently great to clear its bed annually of the deposition of silt due to the smaller volume and velocity of its winter stream. The figures given in the table show that the volume of water passing Nukus on the 10th of September was a little more than one-third only of the total discharge of the river on the 3rd of August, on which date, it is probable, the Amú Darya reached its maximum height for 1874. I am inclined to think, from a consideration of the winter discharges which are recorded by Wood in his work on the Upper Oxus, that the minimum volume of water passing Nukus during the winter months of any year is not very much less than that which passed the same point on the 10th September, 1874. However, it is impossible, in the present state of our information, to state with precision either the volume of discharge during the winter months, or the quantity of water required to pass during the summer, to scour out the deposits made in the bed of the Amú by the winter discharge. But those who are inclined to confide in the intelligent arrangements of nature, will have no difficulty in believing that these two volumes were in such a state of proportion as corrected the evils induced in the bed of the river by the low velocity of the smaller of the two volumes, *i.e.* of the winter discharge of the Amú. Under such circumstances, the bed of the river would be undeteriorated, its course would remain constant, and its flow would continue into the Caspian Sea.

But immediately the volume and velocity of the summer or flood discharges of the Amú Darya were decreased by the action of defluent canals excavated for the irrigation of the lands of Khiva, the compensatory arrangements of nature, which previously kept the river's bed clear, would be interfered with, and some portion of the silt deposited by the winter stream would remain unremoved. This evil would increase yearly, and the intensity of its action would be greater as the quantity of water diverted for irrigation purposes became greater. A portion of the deposit might occasionally be removed by an accidentally high flood, but, eventually, a state of things would supervene in which the conditions of the Amú would present the precise converse of the state of adjustment described in Sir Charles Lyell's work; that is to say, bars and banks of sand would form in the course of the river, would be enlarged yearly, and would prevent it from flowing on to the Caspian. The most westerly point reached by the waters of the river would continually recede to the east, and they would become erratic while seeking an outlet by a slope steeper than that of their encumbered old bed.

Such is a tolerably concise description of what I conceive has actually occurred in the case of the Amú, and has caused the change of its flow into the Aral Sea; and it now remains to examine whether such facts as are known regarding the change and the existent state of things are in harmony with the theory I have ventured to hazard.

Abulgazee Khan, in his history of the Mogols and the Tartars, relates that in the early part of the sixteenth century "all the road from Urgenj as far as Abul Khan was covered with aouls, *i.e.* encampments of nomads; for the Amú Darya, after having passed under the walls of Urgenj, flowed to the foot of the eastern slope of Mount Abul Khan, whence the river turned to the south-west, to turn afterwards to the west, and empty itself at Ogourtcha into the Sea of Mazanderan. The two banks of the river as far as Ogourtcha presented a succession of cultivated lands, of vineyards and of orchards . . . All that country was at that time very populous and in the most flourishing condition." In the early part of the sixteenth century, therefore, the Amú Darya fell into the Caspian, and irrigation, by means of its waters, was general along its banks from Urgenj as far as Abul Khan.

Anthony Jenkinson, the Englishman travelling from the Caspian eastwards in A D. 1559, arrived on the 5th October at what he called a "gulfe of the Caspian Sea." Here he found "the water very fresh and sweete." He continues: "Note that in times past there did fal into this gulfe the great river Oxus, which hath his springs in the mountains of Parapomisus, in India, and now cometh not so far, but falleth into another river called Ardok, which runneth towards the north. . . ." The "very fresh and sweete water" found by Jenkinson could only have been brought by a flood, or have forced its way either by a channel or by filtration through the sand-banks into the old bed of the Oxus to the spot in question. At the date mentioned, therefore, by Jenkinson, some of the waters of the Amú Darya could still find their way to the Caspian, and the opening of the new course into Ardok, and the closing of the old course, must have been circumstances of tolerably recent occurrence.

Jenkinson continues his narrative thus:—"We, having refreshed ourselves at the forsaid gulfe, departed thence the 4 day of October (either this or his first date, therefore, is a mistake), and the seventh day arrived at a Castle called Sellizure. . . . The Castle of Sellizure is situated upon a high hill. . . . The south part of this Castle is lower land, but very fruitful, where grow many good fruites . . . the water that serveth all that country is drawen by ditches out of the river Oxus, unto the great distruction of the said river, for which cause it falleth not into the Caspian Sea as it hath done in times past, and in short time, all that land is like to be distroied, and to become a wilderness for want of water, when the river of Oxus shall fail."

This apprehension was soon to be realised, for Abulgazee relates, in the work already quoted from, that thirty years before his birth, *i.e.* in A.D. 1575, the Amú Darya found a passage for itself into the Sea of Aral; a circumstance which changed the environs of Urgenj into a desert by depriving them of the water necessary for the irrigation of the soil.

From the foregoing extracts we learn that, commencing with some year early in the sixteenth century, the stream of the Amú Darya, year after year, fell short of reaching as far to the west as it formerly did, until in A.D 1575 the new channel into the Aral conveyed the whole of the waters which remained after the irrigation of the lands of the Khanate lying on the course of the river above Urgenj had been provided for.

As regards the actual condition of the old and present beds of the Amú Darya, the levelling operations carried out in 1873 and 1874 afford the following data:—

Height of	Aral . .	above	Caspian	250	feet.
,,	Igdy . .	,,	Caspian	190	,,
,,	Nukus. .	,,	Aral .	60	,,
,,	Nukus. .	,,	Caspian	310	,,
,,	Bend . .	,,	Aral .	70	,,
,,	Bend . .	,,	Caspian	320	,,
,,	Shahbazwali	,,	Aral .	140	,,
,,	Shahbazwali	,,	Caspian	390	,,

Distance	along old Amú	from	Caspian	to	Igdy . .	200	miles.
,,	,,	,,	Urgenj	,,	Igdy . .	274	,,
,,	,,	,,	Urgenj	,,	Bend . .	43	,,
,,	,,	,,	Urgenj	,,	Shahbazwali	133	,,
,,	,,	,,	Bend .	,,	Nukus .	17	,,

The foregoing distances are taken along the meanders of the bed.

						Inches.
Hence the slope	per mile	from the	Caspian .	to	Igdy .	is 11½
,,	,,	,,	Urgenj .	,,	Igdy .	,, 3¾
,,	,,	,,	Bend . .	,,	Urgenj	,, 3¾
,,	,,	,,	Shahbazwali	,,	Urgenj	,, 8½
,,	,,	,,	Shahbazwali	,,	Bend	,, 9¼
,,	,,	,,	Bend . .	,,	Nukus	,, 7¼

From the foregoing I infer Urgenj to be 56½ ft. above Aral, and 306½ ft. above the Caspian.

The following are the conclusions I draw from the foregoing data:—

1. That the old bed between Urgenj and Igdy, having the abnormally small slope of 3¾ in. per mile, has probably been raised by the deposit of silt carried by the waters of the river.

2. That the bed of the Kunya Daryalik, which commences opposite Shahbazwali, having a slope of 8½ in. per mile above Urgenj, discharged a larger body of water than the bed below that place. The difference of the discharges must have been disposed of in irrigation, and the abstraction of water from the Kunya Daryalik was the cause of the silt deposited in the bed of the river below Urgenj, as well as of that in the Kunya Daryalik itself.

3. The bed of Kunya Daryalik having a slope of 8½ in. per mile, while that of the present river, downwards to Bend, from the head of the Kunya Daryalik, has a slope of 9¼ in., it follows, that the slope of the old course must have been flattened from something steeper than 9¼ in. per mile to 8½ in. per mile; otherwise, the waters of the river could have never passed by the Kunya Daryalik towards Urgenj.

4. The water passing along the old Amú being headed back by the deposition of silt in the old bed of the river, became erratic during floods, and found an outlet by the Ardok channel, which eventually carried all the waters of the Amú Darya towards Nukus.

5. The small difference of slope per mile of the beds of the Kunya Daryalik, and the present Amú Darya, explains the tendency of the flood waters to escape from the river, and the necessity of the dams found along the old course. And since the slope of the bed of the Amú Darya down to Bend is 9¼ in. per mile, while that from Bend to Nukus is 7¼, there must always be a tendency, during floods, for the waters to be headed back at Bend, and so to seek an escape by the Loudon channel, across the mouth of which a dam has been constructed to prevent such an occurrence. The condition of the bed of the Amú Darya, from where the irrigation canals commence, down to Bend, fully accords with the theory of the change of the course of the river developed in this note. Descending from the point indicated, the bed of the river is more and more encumbered

with shoals, until in the reach where Bend is situated, and where the maximum volume has been abstracted for purposes of irrigation, the entire breadth of the Amú Darya is obstructed by a mass of sandbanks intersected by narrow and tortuous channels.

It appears, then, that such information as we have, regarding the change and the existent conditions of the old and new courses of the Amú Darya, presents a picture precisely the converse of that delineated in and quoted from Sir Charles Lyell's work. In lieu of a constant increase to the transporting capacity of the waters of the river, we see that in the Amú Darya such is replaced by a constantly diminishing transporting power, and that the old bed has been filled up and destroyed by the deposition of silt. This deposition of silt and deterioration of the bed can only have been caused by the abstraction of its waters for irrigation. Whether other circumstances assisted the consequent change of the flow of the Amú Darya is a question it is not my purpose to examine in this place. Enough has, I would submit, been adduced to show that the practice of irrigation, as conducted on the banks of the Amú Darya, produces phenomena whose action furnishes a probable explanation of a very curious and interesting geographical problem. HERBERT WOOD

THE PARIS INTERNATIONAL CONGRESS OF GEOGRAPHICAL SCIENCE

THE meeting of the International Congress, of which we published the programme a few months ago (vol. x. p. 267), has been postponed, owing to the large number of demands from foreign parts for room in the Exhibition. It will not take place in the beginning of spring as intended orginally, but will be opened on the 1st of August, perhaps by the President of the Republic, who seems to be deeply interested in the success of the enterprise. It will be held in the Pavillon de Flore. This magnificent building was left unfinished when the Empire was upset, and could not be burned by the Communists, as the woodwork had not been begun. It is now being decorated most tastefully, and will be inaugurated by the Congressionists.

An exhibition will also take place in the Pavillon de Flore and Orangerie situated close to the Place de la Concorde. All the Terrace du Bord de l'Eau, from the Pavillon de Flore to the Orangerie, will form part of the Exhibition. Temporary sheds of every description will be constructed in that splendid situation along the banks of the Seine and under the four rows of lofty trees. The *coup d'œil* will be splendid, and is sure to attract an immense number of spectators. The Exhibition will be opened on the 19th of July, and will last until the 4th of August. A very large number of gentlemen of all countries have been appointed members of the honorary committee. The president of the Congress is M. Delesse, a French engineer in the mining service, and a great geologist. M. Delesse is now the president of the Central Committee of the Geographical Society. Up to the present moment the vice-president has not been elected.

The Exhibition and Congress, as we formerly notified, have been divided into seven different groups: (1) Mathematical; (2) Hydrographical; (3) Physical; (4) Historical; (5) Economical; (6) Didactic; (7) Travels.

A programme of 123 questions has been published, and all these, as far as possible, will be discussed by the members of the Congress. The principal questions will be found in the article referred to.

ON THE ALTERATION OF THE NOTE OF RAILWAY WHISTLES IN TRAINS MEETING EACH OTHER

I AM not aware whether the following explanation of this curious acoustical phenomenon has ever appeared in print; if it has, it will, I think, bear repetition, as offering an interesting illustration of some of the laws of propagation of undulations through aërial media.

If two railway trains meet and pass each other at tolerable speed, and the driver of one of them is sounding his whistle, any person in the other train accustomed to music will notice that the moment the whistle passes him its note will be *lowered in pitch* in a marked degree.

It was at first supposed that, at the time of passing, the driver lowered his whistle intentionally, as a salute to the other train (like "dipping the ensign" at sea), but this was found not to be the fact, the driver himself being unconscious of any change. I believe the true explanation was first given by Mr. Scott Russell, but I do not know when or where.

It is an exactly parallel case to one which has recently attracted attention in astronomy, namely, the evidence afforded by the change in position of certain spectral lines, owing to the vapours which produce them approaching or receding from the observer. The explanation of this will be familiar to most of the readers of NATURE, and I have only to apply it to the case in question.

Every musical note propagates aërial waves succeeding each other with a known rapidity, corresponding to the pitch of the note; the higher the pitch, the greater the rapidity of succession of the waves, and *vice versâ*. Now, when a person advances to meet these waves, more of them will pass him in a given time than if he stood still, on the same principle that if a man meets a file of soldiers on march, more men will pass him per minute than if he were stationary. Thus the apparently increased rapidity of the waves will give him the impression of a *sharper* note.

On the other hand, when the trains have passed each other, the listener will be moving in the same direction as the sound-waves, and consequently a *less* number will pass him in a given time, causing the note to appear *flatter*.

The sum of these effects will be the sudden *drop* of the pitch of the note at the moment the listener passes the whistle.

We may reduce the effect to numerical calculation, premising that, in order to simplify the reasoning, we will suppose the source of the sound to be stationary, and the observer to move towards it with a given velocity.

Let n = number of sound-waves propagated by the given note per second; and let n_1 = the number which the listener will gain by his advance in the same time, which is the number he would pass *by his own proper motion* if the waves were standing still.

Then the effective number of waves per second which will meet his ear will be $= n + n_1$, this number determining the pitch of the note he hears. This may be called (by an astronomical analogy) the *apparent* pitch, as distinguished from the *true* pitch.

To find the value of n_1, let L = the *length* of the sound-wave $\left(= \frac{V}{n}\right.$ where V = velocity of sound in feet per second). Then, if v = velocity of motion of the listener he would pass, by his own proper motion, $\frac{v}{L}$ waves per second; whence $n_1 = \frac{v}{L} = \frac{n\,v}{V}$.

Hence the apparent pitch of the note is what will correspond to the number of vibrations

$$= n + \frac{n\,v}{V} = n\left(1 + \frac{v}{V}\right).$$

But we may simplify this by applying the harmonic principle, that a musical interval is measured by the ratio of the vibration numbers of its higher and lower limiting sounds. Let therefore δ = the interval between the real and the apparent sound; then

$$\delta = \frac{n\left(1 + \frac{v}{V}\right)}{n}$$

or $$\delta = 1 + \frac{v}{V} \quad \text{or} \quad = \frac{V + v}{V}$$

A very simple formula, in which the original number of waves disappears, showing that the interval between the two notes is irrespective of the original pitch of the whistle, and depends only on the velocity with which the listener approaches the source of the sound.

We have now to take the case where the listener, having passed the whistle, is receding from the source of sound. The note will then appear flatter than the real one, and its vibration number will be found by the same rule as before, merely giving v a minus sign.

$$= n\left(1 - \frac{v}{V}\right)$$

And the *interval*, i.e., the ratio of the vibrations of the higher to that of the lower, denoted by δ_1 will be

$$\delta_1 = \frac{n}{n\left(1 - \frac{v}{V}\right)} = \frac{V}{V - v}$$

These two intervals added together will express the *drop* of pitch of the whistle at the time of passing.

But to add intervals together we must multiply their ratios; hence if δ_2 represent the drop,

$$\delta_2 = \frac{V + v}{V - v}$$

from which the drop of the whistle corresponding to any speed may be found.

To simplify the reasoning, we have supposed the whistle to be stationary and the listener to move with a velocity $= v$. If both move, as is the usual case in railway trains meeting, v must be made = the sum of the speed of the two.

Taking $V = 1120$ feet per second for ordinary conditions, the following table shows the value of the *drop* for different speeds:—

Conjoint speed of the two meeting trains.		Corresponding drop of the note of the whistle.
Miles per hour.	Feet per second.	
24 ...	34 ...	A semitone $\left(\frac{16}{15}\right)$
45 ...	66 ...	A whole tone $\left(\frac{9}{8}\right)$
70 ...	102 ...	A minor third $\left(\frac{6}{5}\right)$
85 ...	125 ...	A major third $\left(\frac{5}{4}\right)$
108 ...	160 ...	A fourth $\left(\frac{4}{3}\right)$
152 ...	224 ...	A fifth $\left(\frac{3}{2}\right)$

I have made observations whenever I have had the opportunity, and find the results corroborate the deductions of theory. The most common interval observed in ordinary travelling is about a third, major or minor, corresponding to a speed of between thirty-five and forty miles per hour for each train. W. POLE

GLASGOW SCIENCE LECTURES

UNDER the title of the Glasgow Science Lectures Association, an organisation has lately been formed in Glasgow, whose object is to provide annual courses of lectures on various branches of science by men of eminence in each department, so as to place in clear and comprehensive outlines the most important results of scientific inquiry before the public of Glasgow, and at such a rate as will secure to those who cannot otherwise obtain it the best information on the state of science, as established by the most recent investigations of its most distinguished workers. The scheme originated amongst a number of working men who were desirous of following the example of the science lecture movement which has been so successfully worked out in Manchester during the last six or seven years, but with this difference, namely, that the lectures should be self-supporting. To accomplish that end, and be in a position to pay the lecturers liberally for their services, they at once saw that the minimum rate of admission could not well be fixed at less than threepence, and they confidently believed that many of their fellows would be most willing to pay that amount for the privilege which it was proposed to place within their reach. They soon enlisted the sympathies and active co-operation of persons in a higher social sphere, and in due time the Association took active shape. A large executive committee was constituted, and Dr. Allen Thomson, F.R.S., one of the most distinguished members of the professorial staff of the University of Glasgow, cheerfully accepted the honorary presidentship of the Association, while a number of other prominent citizens were enrolled in the list of vice-presidents.

Owing to the fact that Prof. Roscoe had been the moving spirit of the Manchester Science Lectures for the People, he was very early communicated with, in the confident hope that valuable advice based upon his practical experience would readily be placed at the service of the originators of the Glasgow lecture scheme. They were not disappointed in their expectations, and, indeed, had they been lacking in enthusiasm and determination to make the scheme a success, they would have been stimulated to action by the various communications which they received from that gentleman.

It was very late in the past year before the Glasgow Science Lectures Association was sufficiently well organised to make any public announcement of its existence; but the active promoters of the movement were most anxious not to allow the whole winter to pass without having some lectures delivered under the auspices of the Association, no matter how short the course might be. Prof. Roscoe most kindly and cheerfully consented to take part in the first or introductory course; and considering that gentleman's peculiar relationship to the Manchester Science Lectures, the committee came to the conclusion that no person could more appropriately assist at the public inauguration of the movement in Glasgow. Accordingly, with his consent, Prof. Roscoe was set down to deliver the opening lecture of the introductory course, and other three distinguished men of science were selected to follow him, namely, Sir William Thomson, Dr. W. B. Carpenter, and Prof. W. C. Williamson, of Owens College, Manchester.

The inaugural lecture was delivered on the evening of Friday, the 8th of January, and it was in every sense a most auspicious beginning. The Glasgow City Hall was chosen as the place for the delivery of the lectures, as the committee were desirous of bringing together the largest audiences that could be convened in any place of public meeting. It holds well-nigh three thousand persons, and on the occasion in question it was crowded. The reception given to the eminent lecturer was most enthusiastic. Dr. Thomson occupied the chair, and in introducing Prof. Roscoe to the meeting and formally opening the first course of lectures, he delivered an exceedingly valuable address, in the course of which he justified the formation of such associations as the one under whose auspices the lectures were to be given. He said that he had no doubt that in the selection of the lecturers the committee of the

Association would always keep in view the possession by the lecturers of those qualities which alone could secure ultimate success in their enterprise, and which might be summed up as follows :—First, the fulness of knowledge which belongs to an accomplished master of his subject ; second, the authority in statement which is derived from original research ; and third, the disposition and power to convey full and accurate information to others with simplicity and clearness.

The subject of Prof. Roscoe's lecture was "The History of the Chemical Elements," and it was most completely and successfully illustrated, especially in the department of spectrum analysis.

Sir William Thomson's lecture will be on "The Tides," in which it is expected that a full exposition will be given of the more important results arrived at by the British Association Tidal Committee in their recent investigations.

Dr. Carpenter has chosen as his subject "Man not an Automaton," with reference to the recent lectures of Professors Huxley and Clifford ; and the concluding lecture, by Prof. W. C. Williamson, will be on "The Dawn of Animal Life."

It is the intention of the committee in future sessions to provide courses of eight or ten lectures, embracing all those branches of science that are susceptible of being treated thoroughly before large and miscellaneous audiences. What the public now want is lectures of the highest class, conveying ample information, but without unnecessary technicality and learned difficulty. The success of the Manchester Science Lectures for the People and of the lectures delivered to the working men in the towns visited by the British Association during recent years, abundantly shows that such a desire is yearly becoming more and more prevalent. JOHN MAYER

ATLANTIC NOTES

Migration of Birds—The Thresher and Whale

IN crossing the Atlantic last September, when 900 miles distant from the nearest point of Newfoundland, two land birds settled on the ship, and after a short rest resumed their flight to the south-east, without partaking of the food which was scattered in various places for them. By the colour of their plumage and motion on the wing, I believe them to be a species of lark. It may well be asked whence did they come, and whither were they going over that vast space of ocean, with no resting-place nearer the continent than the Azores ? How were they fed during their long journey, and what guided them on their course ? for it is only reasonable to suppose they had come on a bee line from their starting point, and even then their muscular powers must have been severely taxed. It appears to me that naturalists are not in possession of the secret which enables birds of passage to go many days without food at a time when their system must be strained to its extreme limit of endurance.

From the result of close observation, I do not believe that land birds are often, if ever, driven to sea by the force of the wind. Some other cause must influence their movements. At the head of the Gulf of Bothnia, when there has not been a storm for many days, I have seen scores of different species around the ship, amongst them the hawk, the owl, the robin, and many others. Are those who alight and stay by the ship the stragglers from the ranks of the armies which annually migrate, the sick and worn who fall out by the roadside to die, whose end in creation has been fulfilled, and their places ready to be taken by the young and strong? This surmise is strengthened by the fact that no care can preserve the lives of these tired birds in captivity; the hawk and dove alike refuse food, and quickly pine and die.

Birds must possess strong affections, as they are always seen in pairs on these long journeys, which is an additional argument in favour of their voluntary flight over the ocean. It is scarcely possible they could remain together in a gale sufficiently powerful to blow them off the land, and more unreasonable still to imagine that the strength which is able to carry them hundreds of miles without a rest should fail to breast an ordinary gale under the shelter of the land. Such facts as these vouch for the facility with which the most remote islands may increase the number of their species without the agency of man.

Off Youghal a gigantic thresher (*Squalus vulpecula*) was passed. It was leaping lazily and obliquely from the water, and after attaining its highest altitude, fell heavily on the surface, without making any effort to ease or guide its descent. This fish was not under fourteen feet in length ; the belly of a pearly whiteness, and the back marked across with broad black bands. I have never seen this fish north before ; but on the whaling grounds of the southern seas it is common. I do not believe it is dangerous to the life of the whale, as is often stated, but am under the impression that the irritation caused by the attacks of the thresher makes the animal vomit up the squid and other small matter on which it feeds. It is not reasonable to suppose that the blows inflicted by so small an instrument as the thresher's tail can have much effect through a foot of blubber. The whale has also many ways of escaping from its puny enemy ; he dives to a depth where the thresher cannot follow, and if he could, his power of inflicting injury would be gone, owing to the resistance caused by the water ; his speed also enables him to escape at all times. The treaty of offence which is said to exist between the thresher and sword-fish appears to me to be very mythical. When the whale is sick or dying, he is doubtless an object of attack to all the shark species, as they wage war with the whaler for the coveted blubber. WM. W. KIDDLE

THE TRANSIT OF VENUS

THE *Times* of yesterday contains some additional news from the Transit parties, specially those of France and Italy.

The French news consists of telegrams from Shanghai in the Northern and from New Caledonia in the Southern Hemisphere. From the former station M. Fleuriais, the astronomer in charge at Pekin, now states that he was fortunate enough to observe all the four contacts, and not two only, as was at first stated. The times were as follows in local mean time :—First contact, 21h. 32m. 42s. ; second, 22h. ; third, 1h. 50m. 15s. ; fourth, 2h. 17m. 13s. Nor is this all ; no less than sixty photographs were taken which M. Fleuriais pronounces good. We have already stated that stations in Northern China are most useful for the application of the Halleyan and direct methods. From New Caledonia the best part of the news refers to the photographic operations, 100 good photographs being secured. Of the contacts, only the interior one at ingress was observed.

The news of the doings of the Italians comes from the party in Bengal, in charge of the distinguished spectroscopist Tacchini, including Dorna, Lafont, Morso, Abetti, and Tacchini. The telegram comes from Maddapore, and the party evidently occupied two stations. The first three observed all four contacts, the last two only the third and fourth.

As before stated, the chief instrument employed by the Italians was the spectroscope—an instrument not recognised in the equipment of any of the English parties.

The observations were of the most satisfactory kind, and the results may lead to a most important discovery in solar physics. The time of interior contact at egress was observed with the most rigorous exactness, both by the ordinary telescopic method and by the spectroscopic method described in our former notes. It was found that the difference between the times of observation by these methods *was more than two minutes*, contact being observed by the spectroscope first. Now, if the contact had been observed last by the spectroscope, there was an obvious condition of the observation to which the dis-accord might have been attributed ; but there is now no room for doubt that the sun's extreme edge which we actually see in a telescope differs physically from the part just within it, although there is no difference to the eye—in fact, that it gives a spectrum of bright lines, while the spectrum of the true subjacent sun gives a continuous spectrum with dark lines. Further, the physical difference to which we refer would probably tend to make this stratum variable in thickness and luminosity. Nay, we may already hazard the question whether there is not here a condition which may have something to do with the various times of contact recorded by observers having object-glasses widely differing either in aperture or in the over- or under-correction of the chromatic dispersion.

Another victory achieved by the Italians is the determination of the nature of the atmosphere of Venus. The ring round the planet, which in the former transits as in the present one was visible round Venus both on and off the sun, indicates in the spectroscrope that in that planet, as in our own, the atmosphere is composed to a certain extent of aqueous vapour.

Mr. Proctor pointed out some time ago the great value of photographs taken at the Cape of Good Hope in combination with those secured at Nertschinsk and Roorkee. We have no information that any photographs were taken at the Royal Observatory at Cape Town, but a correspondent informs us that fourteen successful photographs were taken at Cape Town, two of them showing distinctly the black drop.

The *Times* then refers to the final appendices to the " Recueil de Memoires, Rapports et Documents relatifs à l'observation du Passage de Venus sur le Soleil," as enabling us at length to refer to the doings of the Commission appointed by the French Government. The records extend from February 1869, when the Government first moved in the matter, to a few months ago, when the final instructions on the methods to be adopted to guard the observations against risk of loss were issued.

The first action of the French Government was to ask the Academy of Sciences to consider the places to be occupied, and the number of observers ; the instruments to be used ; the additional researches which might be undertaken by the observers sent to the Southern Hemisphere ; and, finally, whether an Astronomical Congress would not be desirable to bring about a uniform system of observations.

A strong commission was at once appointed, composed of mathematicians, astronomers, physicists, and chemists, in order that the problem might be considered in an efficient manner. Strangely enough, the name of M. Leverrier, the distinguished Director of the Paris Observatory, does not appear on the commission ; he did not think the observations of the Transit necessary to prove the accuracy of his values of the solar parallax. Happily, his voice was overruled. The course taken, as the *Times* remarks, suggests how desirable some similar procedure here would have been.

"There are very many points of the greatest interest," the *Times* continues, " raised by the contents of this large volume to which we should refer did space permit ; from beginning to end it shows how a nation should set itself to work — how all the intellect of a nation can and must be utilised, when a great problem involving many kinds of special knowledge has to be attacked. It is often said that in France science is crushed by a dead weight of officialism, and that in England it is free. However true this may be of teaching, there is ample evidence in this volume that, in one branch of research at least, the very opposite of this statement is much nearer the truth, and the painful discussions which some time ago occurred in our own columns and elsewhere, the 'Appeals to America,' the action of the Board of Visitors of the Greenwich Observatory, and the like, afford a strong argument—if, indeed, one were needed—that the growth of science necessitates that in all future national enterprises of the kind the example of the French and of all the other Governments should be followed. In this way only, in our opinion, can the national scientific honour be upheld, while the officials concerned in carrying out the work would be strengthened in their positions and shielded from a responsibility too great for individuals to bear."

NOTES

THE arrangements for securing observations of the Solar Eclipse of April 6 are progressing most satisfactorily, thanks to the energy of the Royal Society Committee and the varied knowledge that has been brought to bear upon the various points of attack. Lord Salisbury has brought the proposed action of the Royal Society before the Council of India, and such instructions have already been telegraphed to India as will probably result in this eclipse being observed with a wealth of observers and instrumental appliances beyond all precedent.

CAPTAIN NARES, who is to command the English Arctic Expedition, has arrived in London. Commander Markham returned on Saturday from Dundee, after having entered six good men, tried seal and whale fishers, as ice-quartermasters. Staff-Surgeon Thomas Colan, M.D., of the *Unicorn*, drill-ship of the Naval Reserve at Dundee, has been selected by the Admirably as senior medical officer of the Expedition. With regard to the proposed German Expedition, the desire is, we believe, if the funds can be raised, to form a scheme of co-operation between the two exploring expeditions. Surely our brother Teutons, richer now than ever they were, and whose zeal for knowledge is proverbial, will not allow this splendid scheme to be marred for lack of funds.

THE Museum of the Royal College of Surgeons contains a series of casts of the interior of the cranial cavity, representing exactly the form and size of the brain (when covered by its membranes), of men of various races, and of many species of animals. With a view to diffuse the information to be derived from the study of these casts, and believing that many educational institutions will be glad to avail themselves of the opportunity of possessing them, the Council of the College has authorised the issue of copies at the lowest price at which they can be reproduced, which will partly depend upon the number likely to be required. The Conservator of the Museum would like those who desire to possess the whole or part of the series, which comprises many rare forms, to communicate with him on the subject.

AT its *séance* of Jan. 11, the Paris Academy elected a corresponding member in the section of Mechanics, in place of the late M. Burdin. Three candidates were proposed—M. Broch, the Norwegian mathematician, who obtained twenty-four votes ; Prof. Stokes, F.R.S., twenty-one votes ; and M. Calladon, one vote. Thus M. Broch was elected by only three votes over Prof. Stokes.

MR. SIMON NEWCOMB, the American astronomer, is now in Paris. He has paid a visit to the Observatory, in order to inquire into the possibility of constructing a large refracting telescope having a lens of one metre in diameter. A sum of

30,000*l.* was, as we have already intimated, placed at his command by Mr. Lick, the celebrated Californian capitalist, who is the founder of the Lick Observatory.

M. Chevreul, the great French chemist and director of the Jardin des Plantes, has been presented by the Minister of Public Instruction with the grade of Grand Officer in the Legion d'Honneur. This promotion is considered as being a compensation for the difficulties raised by the Ministry in the appointment of a Professor in the Museum. These quarrels had induced the venerable *savant* to resign.

The *Bulletin* of the French Geographical Society for December contains an exceedingly interesting and carefully compiled paper by M. H. Duveyrier, entitled "L'Afrique Necrologique." This is a list of all the African explorers, from 1800 to 1874, who have met their death while doing their work, either from disease caught in the country, or by murder, or other causes; a very large proportion have died from "intermittent fever." The list includes not only those whose object was purely geographical discovery, but also those whose researches were connected with geology, meteorology, botany, zoology, ethnography, archæology, or languages. The list is a sadly long one, numbering about 150; and M. Duveyrier, in each case, gives a brief account of the explorer and of the work which he accomplished; a large proportion of these martyrs to science are English. Accompanying the paper is an ingeniously constructed map, showing the place at which each traveller met his death.

It is announced that the committee to whose hands the Sub-Wealden Exploration is entrusted have resolved to abandon the present boring after six ineffectual efforts to recover tools which have dropped down and obstructed the whole. The Diamond Boring Company having made a very favourable offer to commence again, a contract for the completion of 1,000 feet for 600*l.* has been agreed to, with a conditional promise to execute the second thousand feet for about 3,000*l.* additional. Mr. Willett, hon. sec., has guaranteed 600*l.*, and appeals for funds to carry on the enterprise.

Mr. Charles Darwin's new work on "Insectivorous and Climbing Plants is in the press and will be shortly published. The following are the contents:—Part I.: On the sensitiveness of the leaves of *Drosera*, *Dionæa*, *Pinguicula*, &c., to certain stimulants; and on their power of digesting and absorbing certain animal matter. Part II.: On the habits and movements of climbing plants. The book will be issued by Mr. John Murray.

Mr. John Murray has also preparing for publication the following two works in travel:—"The Land of the North Wind," being an account of travels among the Laplanders and Samoyedes, and along the coast of the White Sea, by Edward Rae; this book will be illustrated by a map and woodcuts: and a description of a journey to Tabreez, Kurdistan, down the Tigris and Euphrates to Nineveh and Babylon, and across the desert to Palmyra, by Baron Max von Thielmann. The title of the book will be "The Caucasus, Persia, and Turkey in Asia," and it will be translated from the German by Mr. Charles Heneage.

Messrs. Longman and Co. have in the press a translation of a work on the Primæval World of Switzerland, by Prof. Oswald Heer, of the University of Zurich. The book will be edited by Mr. James Heywood, M.A., F.R.S., and will be issued in two octavo volumes with numerous illustrations. The same firm will shortly publish a series of Elementary Lessons on the Structure of Man and Animals, with special reference to the principles affecting health, food, and cooking, and the duties of man to the animal creation; by Mrs. Buckton. This volume will be illustrated with wood engravings.

In the *Astronomische Nachrichten*, Nos. 2,009 and 2,016, are notes on the spectroscopic observation of fifty-two stars made by M. D'Arrest. The stars are chiefly of the 6th and 7th magnitude, and appear in the Bonn Catalogue. The colours of thirty-four of these stars are given, and the type to which each star belongs is generally mentioned. From an analysis of the notes we gain that there are in the list four red or reddish stars of type III. and two of type IV.; of reddish yellow stars there are nine of type III.; of yellow or orange stars there are thirteen of type III., and of the same type one brown and five colourless ones; on the remaining eighteen there are no remarks on colour. The author remarks on the different grades of spectra of type III., from an almost line spectrum to a discontinuous one of bands, as that of α Herculis, but that grades of colour do not always agree with grades of spectrum; and he thinks that the theory that the coloured stars are older because cooler than others cannot be received without numerous exceptions, and he has concluded that the temperature of the coloured stars may in general be lower than that of others, but that it is not proved; and further, that the greater age of these stars is without foundation. The author appears to take exception to the part of the address of M. Wurtz at the French Association, reported in Nature, vol. x. p. 350, where he says of the stars, "We have classed them according to their ages. Stars coloured, stars yellow, stars white; the white are the hottest and the youngest . . . the coloured stars are not so hot, and are older." It certainly seems from M. D'Arrest's observation that there are exceptions to this rule, and a large number of stars must have their spectra and colours tabulated before it can be judged how far this law holds good.

At the last meeting of the Photographic Society a paper was read by Mr. Hooper, "On the Origin, Aim, and Achievements of the Photographic Society, with suggestions as to its future development." The suggestions were, the necessity of obtaining a Royal Charter, the Society's claim upon the Government for a money grant and suitable premises, and the necessity of forming committees for scientific investigation. In the subsequent discussion, the general opinion was that there was little hope of obtaining the proposed Charter, and that it was a mistake to speak of photography as a science. "Science," one speaker said, "had done a great deal more for photography than photography had done for science."

At the meeting of Convocation of the London University on Tuesday, the motion brought forward by Mr. A. P. Hensman, "That, in the opinion of Convocation, it is desirable that women should be permitted to take degrees in Arts in this University," was, after some discussion, withdrawn.

A recent decision has been given by the French Ministry in favour of female doctors. A certain Mdlle. Domerque, of Montpellier, has received due authorisation to pass her examination for the doctorship.

We are glad to see that by the decision of the Supreme Court at Sydney, N.S.W., Mr. Gerard Krefft has been restored to his position and house as Curator of the Sydney Museum. Mr. Krefft has been connected with the Museum for fourteen years, and in September last had been violently ejected by an order from the trustees, who, it seems, had in this exceeded their powers.

The prospectus lies before us of a new Italian monthly journal, to be entitled, *Rivista Popolare di Scienze e Lettere*. Judging from the prospectus, its projectors have a high idea of the important place which science is daily assuming in the life of the world, and intend to devote a considerable proportion of the pages of their Review to subjects of scientific interest. The programme of the new journal is very comprehensive, embracing all departments of philosophy and physical science, and we most heartily wish it complete success. The prospectus is dated from Lentini, in Sicily, where, we believe, the Review is to be published. It seems rather strange to make such an out-of-the-way place the head-quarters of so important an undertaking; we hope, however, its circulation won't suffer in consequence.

THERE are many signs that Italy is really awakened from her long dormancy and seems quietly determined to do her share of the modern world's work. The above announcement may be regarded as one, and we know that in more than one of the sciences valuable work is being done by Italians. In geography, especially, they seem inclined to revive the reputation which of old their country had; they have recently produced one or two noteworthy explorers, and their geographical magazine, *Cosmos*, is a model of typography and good editing. Only on Monday last, Prince Humbert, in returning thanks for his election as President of the Italian Geographical Society, spoke with warm approval of the project of an expedition to the African great lakes, and hoped that Italy would be worthily represented at the forthcoming Geographical Congress at Paris.

THE Queensland Government have received information that Hume, who proceeded in search of Classan, a supposed survivor of the Leichardt Exploring Expedition, perished for want of water fifty miles from Drynan's station on the Wilson River, in the Warrego district. O'Hea, another of the party, is also supposed to be dead. The third man, Thompson, has reached Drynan's station.

As about forty ladies and gentlemen have signified their intention to become members of the proposed Natural History Society at Watford, a meeting to found the Society and to elect a provisional committee will be held at the Watford Public Library on the 23rd inst., at seven o'clock.

P. W. WRIGHT, one of the late porters at the College of Surgeons Museum, commenced duty as dissecting-room porter at St. Thomas's Hospital about a fortnight ago. On last Tuesday week he wounded himself in the hand with a knife whilst assisting in a post-mortem on a child which had died of pyæmia. We regret to hear that he died in consequence of the wound, from the same disease, on Monday last, leaving a wife and five young children quite unprovided for.

M. J. DEBY, in examining the contents of the stomachs of mussels (*Mytilus edulis*) from the Brussels market, found thirty-seven species of diatoms, including *Hyalodiscus stelliger*, a species found previously only in Florida.

THE death of the veteran Dr. Gideon Lincecum, of Long Point, Texas (U.S.), is announced as having taken place at his residence on the 28th of November last, in his eighty-second year. Dr. Lincecum was well known to the naturalists of the United States on account of his abilities as an observer and the wonderful minuteness of his investigations into the habits and peculiarities of American animals. His contributions in this direction to the archives of the Smithsonian Institution, to the *American Naturalist*, to the Academy of Natural Sciences, and to the *American Sportsman*, were very numerous and varied. In addition to his contributions of notes, Dr. Lincecum was an extensive collector of specimens, especially of insects and reptiles of which he sent large numbers to the museums of the United States.

PROF. MARSH and his exploring party returned to New Haven, U.S., on Dec. 12, after an absence of two months in the Rocky Mountains. The object of the present expedition was to examine a remarkable fossil locality, discovered during the past summer in the "Bad Lands" south of the Black Hills. The explorations were very successful, notwithstanding extremely cold weather and the continued hostility of the Sioux Indians. The fossil deposits explored were mainly of Miocene age, and, although quite limited in extent, proved to be rich beyond expectation. Nearly two tons of fossil bones were collected, most of them rare specimens, and many unknown to science. Among the most interesting remains found were several species of gigantic *Brontotheridæ*, nearly as large as elephants. At one point these bones were heaped together in such numbers as to indicate that the animals lived in herds, and had been washed into this ancient lake by a freshet. Successful explorations were made, also, in the Pliocene strata of the same region. All the collections secured go to Yale College, and will soon be described by Prof. Marsh.

DR. HUNT gives an account, in the Proceedings of the Boston Society of Natural History, of the contents of the stomach of a mastodon lately found in Wayland, New York. These consisted of remains of both cryptogams and flowering plants, exhibiting distinctly the vegetable characters. No sphagnum was found in the deposit. The evidence was that the animal had eaten his last meal from the tender mosses and boughs of the flowering plants growing on the banks of streams and margins of swamps, and that pines and cedars formed no part of his diet.

CARRIER pigeons have been employed for a new purpose. When his Majesty of Spain was nearing Barcelona, a Spanish steamer was sent to meet *Los Navos* on the high seas, and succeeded in doing so at the distance of 150 miles from the seaport. Carrier pigeons were then liberated so as to announce in Barcelona the happy coming of Don Alphonso XII. The experiment appears to have been successful. It is said that carrier pigeons were in use among the old Roman navigators in the time of the Cæsars. The practice was discontinued for centuries, and the question has been asked by some French papers whether it is desirable to revive it for Transatlantic steamers.

THE Signal Service observer on the summit of Pike's Peak (U.S.) reports that the local storms there experienced originate over the parks to the westward on hot afternoons. On one occasion he was favoured with an excellent view of the interior structure of the clouds of a tornado, when he observed that while the cloud-bearing currents of air float toward the centre, they had a decided downward movement, but that masses of smoke-like vapour rapidly ascended through the interior funnel.

IN a paper read by Capt. Shaw, of the Metropolitan Fire Brigade, at the Society of Arts on Tuesday night, an ingenious apparatus was described for enabling persons to breathe in dense smoke or poisonous vapours. It consists essentially of a close-fitting hood, with a respirator, holding a filter, the invention of Prof. Tyndall, which consists of a valve chamber and filter tube about 4 inches long, screwed on outside, with access to it from the inside by a wooden mouth-piece. The charge for the filter consists of the following materials, which are put in with the tube turned upside down, and the lower valve removed:—Half an inch deep of dry cotton-wool, an inch deep of the same wool saturated with glycerine, a thin layer of dry wool, half an inch deep of fragments of charcoal, half an inch deep of dry wool, half an inch deep of fragments of lime, and about an inch of dry wool. The whole can be put on and adjusted in a few seconds by the wearer.

THE additions to the Zoological Society's Gardens during the past week include a Pig-tailed Monkey (*Macacus nemestrinus*) from Java, presented by Dr. Cole; a Crested Porcupine (*Hystrix cristata*) from Mogadore, presented by Mr. Alfred Hay; two Chukar Partridges (*Caccabis chukar*) from North-west India, presented by Capt. Murray; a Sooty Mangabey (*Cercocebus fuliginosus*), and a Patas Monkey (*Cercopithecus ruber*) from West Africa; an Australian Goshawk (*Astur approximans*) from Australia, purchased; an Ocelot (*Felis pardalis*) from America, deposited.

SCIENTIFIC SERIALS

Poggendorff's Annalen der Physik und Chemie, No. 10.—This number contains several papers of great interest: the first is by G. Quincke, on electric currents resulting from the non-simultaneous insertion of two mercury-electrodes into different liquids. The author bases his experiments upon those of St. Claire Deville and Troost, who found it probable that platinum absorbs hydrogen or other gases when being heated in a gas or alcohol flame, and then shows a different electric action towards water and dilute acids from that of platinum that has not been so heated. The paper contains a minute description of the apparatus used and tables of the results obtained; in an appendix the author treats of the relation between capillary and electrical phenomena, referring to G. Lippmann's paper (*Pogg. Ann.*, vol. 149, p. 556), from whom he materially differs.—Experiments made with a magnetised copper wire, by Prof. Balfour Stewart and Dr. A. Schuster.—On the chemical action of the solar spectrum upon haloid salts of silver, by H. W. Vogel. Chloride, bromide, and iodide of silver, are not only sensitive towards the highly refrangible rays of the spectrum, but also towards the less refrangible ones, although in a much smaller degree; their sensitiveness does not only depend upon their optical power of absorption of the respective rays, but also upon the absorption power of other substances they may be mixed with. Coloured substances which assist the photographic reduction process and absorb certain spectral rays, highly increase the sensitiveness of the silver salt towards the absorbed rays; thus the sensitiveness of silver salts for red, yellow, and green rays can be greatly augmented. Certain colourless bodies are found to have a similar action. The light reflected from pigments shows a very different effect from that of spectral colours, on account of the varying optical composition of artificial colours and their smaller intensity.—On the question of velocity of magnetic action at distances, by H. Herwig; investigations relating principally to terrestrial magnetism. It is found that this velocity is at least half a million geographical miles (or about 2¼ millions of English miles) per second; in other words, that at any given spot on the surface of the earth terrestrial magnetism becomes fully active in less than the 300th part of a second.—On a modification of the magneto-electric revolution experiment, by the same.—On comparison of electric machines, by Mr. Mascart. The author describes experiments made to ascertain the actual quantity of electricity produced by eleven different machines in a given time and under the same conditions.—On the measuring of the electromotive power of voltaic piles in absolute units, by A. Crova.—The frequency of changes of colour in the scintillation of stars is generally related to the spectrum they show, by C. Montigny. Stars that twinkle strongly show few spectral lines, while those with little scintillation have many bands and lines in their spectra.—On the theory of organ-pipes, by H. Schneebeli.—Is the application of the *vis viva* justified in the mechanical theory of heat? by H. Fritsch. The author answers this question in the negative.—On induction-effects in magnets of different hardness, by L. Külp.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Jan. 7.—"Remarks on a New Map of the Solar Spectrum," by J. Norman Lockyer, F.R.S.

I beg permission to lay before the Royal Society a portion of the new map of the solar spectrum, referred to in one of my former communications.

It consists of the portion between w. l. 39 and 41.

I have found it necessary, in order to include all the lines visible in my photographs in such a manner that coincidences may be clearly shown, to construct it on four times the scale of Angstrom's "Spectre-Normal."

The spectra of the following elements have been photographed side by side with the solar spectrum, and the coincidences shown:—

Fe, Co, Ni, Mn, Ce, U, Cr, Ba, Sr, Ca, K, Al.

The wave-lengths of new lines in the portion of this spectrum at present completed have been obtained from curves of graphical interpolation. Instead of the reading of a micrometer-scale, a photographic print of the spectrum has been employed in the construction of these curves, the wave-lengths of the principal lines being taken from an unpublished map of the ultra-violet region of the solar spectrum, a copy of which has been kindly placed at my disposal by M. Cornu. The photograph of the solar spectrum, from the ultra-violet to beyond F, kindly given to me by Mr. Rutherford, has also proved of great service in the present work. I have, in fact, up to the present time, only been able to excel this photograph in the region about H. 1

From the extreme difficulty of carrying on eye-observations upon the portion of the spectrum now completed, Angström's map is, of course, very incomplete about this region. The few lines mapped differ slightly in some cases from the positions assigned by Cornu; but the wave-lengths given by the latter observer generally fall into the curve without breaking its symmetry, and these positions have therefore been adopted. The advantage possessed by the photographic method over eye-observation may be estimated from the following numerical comparisons:—

Region of spectrum, 3900–4100.

Number of lines in Angström's "Spectre-Normal"	39
" " Angström's and Thalén's map of the violet part of the solar spectrum ...	185
" " Cornu's map	205
" " New Map	518

It will serve further to illustrate the advantages of the photographic method, to compare the number of lines in the spectra of metals already observed with the number of lines of the same metal given by Angström in the "Spectre-Normal."

Region of spectrum, 3900–4100.

Metal.	Lines in new map.	Lines in Thalén's map.
Fe	71	19
Mn	53	12
Co	47	—
Ni	17	—
Ce	163	—
U	18	—
Cr	24	—
Ba	7	—
Sr	5	—
Ca	7	6
K	2	—
Al	2	2
	Total ... 416	Total ... 39

The purification of the various metallic spectra has at present been only partially effected; but I have seen enough already to convince me of the extreme rigour with which the principle I have already announced may be applied, while at the same time there are evidences that the application of it may lead to some results not anticipated in the first instance.

My object in laying these maps before the Society, and presenting this *ad interim* report of progress, is to appeal to some other man of science, if not in England, then in some other country, to come forward to aid in the work, which it is improbable that I, with my small observational means and limited time, can carry to a termination. I reckon that, having regard to routine solar work, it will require another year before the portion from H to G is completely finished, even for the metals the spectra of which are shown in the maps now exhibited. When this is done there will still remain outstanding all the ultra-violet portion, the portion from G to F, both capable of being photographed by short exposure, and the whole of the less refrangible part, which Draper and Rutherford have both shown can be reached by long exposure with the present processes.

I cannot but think, moreover, that when the light which the spectroscope has already thrown upon molecular action shall be better known, and used as a basis for further inquiry, methods of photography greatly exceeding the present one in rapidity, in the less refrangible portion of the spectrum, will be developed and utilised in the research.

The map is being drawn by my assistant, Mr. Raphael Meldola (to whom my thanks are due for the skill and patience he has brought to bear upon the work), in the first instance with more especial reference to the positions, thicknesses, and individualities of the lines; the final revision will consist of an absolute intensity reproduction of the photographs.

"On the Spectrum of Coggia's Comet," by William Huggins, D.C.L., LL.D., F.R.S.

From his observations of five small comets in the years 1866, 1868, and 1871, the author had shown that a great part of the light of those comets was emitted by the cometary matter; and further, that carbon, in some form, was probably present in them.

Coggia's Comet presented in the spectroscope three distinct spectra :—

1. A continuous spectrum from the light of the nucleus.
2. A spectrum of bright bands.
3. A continuous spectrum accompanying the gaseous spectrum on the coma, and representing almost entirely the light of the tail.

The author then gives his observations of three different spectra, and of the relative intensity of the two latter spectra in different parts of the comet.

On acoustic reversibility, by J. Tyndall, D.C.L., LL.D., F.R.S. In this paper Prof. Tyndall refers to the series of experiments on the velocity of sound which were made on the 21st and 22nd of June, 1822, between Villejuif and Montlhéry, south of Paris, and 11·6 miles distant from each other.

On this occasion it was noticed that while every report of the cannon fired at Montlhéry was heard with the greatest distinctness at Villejuif, by far the greater number of the reports from Villejuif failed to reach Montlhéry. The air at the time was calm, the slight motion of translation actually existing being from Villejuif towards Montlhéry, or against the direction in which the sound was best heard.

So far as the author knows, no explanation of this has hitherto been given.

Experimenting with a sensitive flame, from 18 to 24 inches in height, and a reed, less than a square quarter of an inch in area, on a screen of cardboard, 18 inches high by 12 inches wide, in all cases it was shown that the sound was effective when the reed was at a distance from the screen and the flame close behind it ; while the action was insensible when these positions were reversed.

It was observed and recorded when the experiments of 1822 were made, that while the reports of the guns at Villejuif were without echoes, a roll of echoes, lasting from twenty to twenty-five seconds, accompanied every shot at Montlhéry, being heard by the observers there.

From various considerations the author infers that Montlhéry, on the occasion referred to, must have been surrounded by a highly diacoustic atmosphere ; while the shortness of the echoes at Villejuif shows the atmosphere surrounding that station to have been acoustically opaque.

The non-homogeneous air surrounding Villejuif is experimentally typified by the screen with the source of sound close behind it; the upper end of the screen representing the place where equilibrium of temperature was established in the atmosphere above the station. In virtue of its proximity to the screen, the echoes from the sounding-reed would, in the case here supposed, so blend with the direct sound as to be practically indistinguishable from it, as the echoes at Villejuif followed the direct sound so hotly, and vanished so rapidly, that they escaped observation. And as the sensitive flame, at a distance, failed to be effected by the sounding body placed close behind the cardboard screen, so, the author takes it, did the observers at Montlhéry fail to hear the sounds of the Villejuif gun.

Something further may be done towards the experimental elucidation of this subject. The facility with which sounds pass through textile fabrics has been already illustrated ;[*] a layer of cambric, or even of thick flannel or baize, being found competent to intercept but a fraction of the sound from a vibrating reed. Such a layer of cambric may be taken to represent a layer of air differentiated from its neighbours by temperature or moisture ; while a succession of such sheets of cambric may be taken to represent successive layers of non-homogeneous air.

Two tin tubes with open ends were placed so as to form an acute angle with each other. At the end of one is the vibrating reed ; opposite the end of the other, and in the prolongation of its axis, is a sensitive flame—a second sensitive flame being placed in the continuation of the axis of the first tube. On sounding the reed, the direct sound through the first tube agitates the second flame. Introducing the square of cambric at the proper angle, a slight decrease of the action on the second is noticed, and the feeble echo from the cambric produces a barely perceptible agitation of the first flame. Adding another square, the sound transmitted by the first square impinges on the second. It is partially echoed, returns through the first square, passes along the second tube, and still further agitates the flame opposite its end. Adding a third square, the reflected sound is still further augmented, every accession to the echo being accompanied by a corresponding withdrawal of the vibrations from the flame opposite the first tube, and a consequent stilling of that flame.

With thinner cambric it would require a greater number of layers to intercept the entire sound. Hence, with such cambric, we should have echoes returned from a greater distance, and, therefore, of greater duration.

Jan. 14.—" On a Class of Identical Relations in the Theory of Elliptic Functions," by J. W. L. Glaisher, M.A., Fellow of Trinity College, Cambridge; communicated by James Glaisher, F.R.S.

Chemical Society, Jan. 14.—Prof. Odling, F.R.S., president, in the chair.—On the action of the organic acids and their anhydrides on the natural alkaloids, Part III., by Mr. G. H. Beckett and Dr. C. R. A. Wright, was read by the latter. It is a continuation of their researches on the opium alkaloids morphine and codeine.—The next communication was a note on the effect of passing the mixed vapours of carbon bisulphide and alcohol over red-hot copper, by Mr. T. Carnelly.—Dr. H. E. Armstrong then read a paper on the iodonitrophenols.

Anthropological Institute, Jan. 12.—Prof. Busk, F.R.S., president, in the chair.—Mr. T. J. Hutchinson, F.R.G.S., late H.M.'s Consul, Callao, read a paper on the anthropology of Prehistoric Peru. The paper commenced with a notice of how little is known up to the present time about the glorious days of Peru long before the time of the Incas, agreeing with Mr. Baldwin as to the original South Americans being the oldest people on that continent. The grandeur of colossal works in the extent of the ancient burial mounds was shown by illustrations. A comparison of these examined by the author in Peru was made with those explored by Messrs. Squier and Davis in the valleys of the Ohio and the Mississippi. The prehistoric architecture of Peru, described by Prof. Raimondi in his recent work on the mineral riches of the department of Aucachs, were mentioned as highly interesting ; more particularly the tombs cut out of solid blocks of diorite in the valleys where sandstone is the geological character ; thus proving the enormous capacity for work of the ancient Peruvians in transporting these stony masses over the Andes. So small was the author's faith in Spanish accounts of South America, that he inclined to the belief in some future explorer finding the mythical "cradle of the Incas" in the National Library at Madrid, instead of in the Lake of Titicaca, to which latter place it is accredited by the Hakluyt Society.—A paper, by Dr. George Dobson, was read on the Andamans and Andamanese. After giving a sketch of the geographical position of the Andaman Islands and their geological and zoological relations to the Asiatic continent, the author passed in review the various theories that had been propounded by eminent biologists to account for the origin of the Andamanese. He strongly inclined to the views of Mr. Wallace and M. Quatrefages that the Andamanese are Nigritos, or Samangs from the Malay peninsula, and was opposed to the theory of their descent from shipwrecked African negroes, on the ground rather of the dissimilarity of their manners and customs than of their physical characteristics. It was impossible, however, to account for the presence of the wild tribes of Southern India or of the peculiar Samangs of the interior of the Malay peninsula, surrounded by races with which they have no connection whatever, except on the hypothesis that they are the few surviving descendants of a woolly-haired people which in ages past occupied lands south of the Himalayas when the continent of Asia included within its southern limits the Andamans, Nicobars, Sumatra, Java, Borneo, and the Philippine Islands ; and that the present inhabitants of the Andamans and the Nigritos of the Philippines are also the remnant of those ancient Nigrito inhabitants of Southern Asia, which have almost disappeared before the invading Aryan and Mongolian races. Dr. Dobson exhibited a series of photographs, taken by himself, of Andamanese men and women.

Entomological Society, Jan. 4.—Sir Sidney Smith Saunders, C.M.G., president, in the chair.—Mr. Stevens exhibited varieties of *Diloba cæruleocephala* and *Hibernia defoliaria*, bred from larvæ taken near Brighton.—Mr. Smith exhibited a box of hymenopterous insects collected in the neighbourhood of Calcutta by Mr. Rothney. It comprised several rare species of *Formicidæ* and *Fossores*, and also many undescribed species of *Apidæ*, amongst which were two species of *Nomia*, one of them with remarkable capitate antennæ.—Mr. M'Lachlan made some remarks on the December Moth (*Cheimatobia brumata*), which he had observed one evening during the recent severe frost, attracted in great numbers to the gas lamps in the neighbourhood of Lewisham. Mr. Weir remarked on the importance of ascertaining whether they were hybernated specimens or whether they had been newly hatched during the severe weather.—A letter was read from Mr. R. S. Morrison, of George Town, Colorado, expressing a wish to be placed in communication with any entomologists who might be interested in the insect faunas of the higher altitudes (8,000 to 14,000 ft.), which he considered should be more fully investigated.—The Secretary exhibited a small bottle containing specimens of a *Mantis*, forwarded to him from Sarawak by Mr. de Crespigny. He stated that while sitting at table his notice was attracted by the unusual appearance of a column of ants crossing it; but on looking more narrowly he observed that they were not ants, but a species of *Mantis*, and he believed them to be full-grown insects, but that they had no wings. Mr. M'Lachlan, however, observed that some of the specimens had rudimentary wings; and the President and others expressed a belief that they would prove to be larvæ, and not perfect insects.

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[*] Phil. Trans., Feb. 1874.

Institution of Civil Engineers, Jan. 12.—Mr. Thos. E. Harrison, president, in the chair.—The paper read was on the construction of gasworks, by Mr. Harry E. Jones.

BERLIN

German Chemical Society, Dec. 19.—Annual ordinary meeting; A. W. Hofmann, V.P., in the chair.—The vice-president reported on the state of the Society, which counts 1,209 members, while the reports are published to the number of 1,800 copies. The number of papers published through its means amounted to more than 500 during the last year. The elections called the resident officers back to their posts, while, as non-resident members of the committee, the following were elected for the new year:—Messrs. Baeyer, Griess, Ladenburg, Landolt, and Schorlemmer.

Dec. 28.—A. W. Hofmann, V.P, in the chair.—P. Wallach and A. Böhringer, in treating methylated oxamine with PCl_5, have produced a well-defined base yielding well-crystallised monobasic salts and a direct combination with C_2H_5I. The base $C_4H_5ClN_2$ has received the name chloroxal methyline, and is homologous with $C_6H_9ClN_2$ lately produced by Dr. Wallach from ethylated oxamine in a similar way.—I. Piccard has succeeded in producing anthrachinone by heating, in closed tubes to 220°, benzol and phthalic chloride with zinc:

$$C_6H_4\begin{matrix}COCl\\COCl\end{matrix}+C_6H_6=C_6H_4\begin{matrix}CO\\CO\end{matrix}C_6H_4$$

I. Siebel proposed as a method for producing soda the treatment of tribasic phosphate of soda with carbonic acid, adding subsequently carbonate of ammonia. The double phosphate of sodium and ammonium crystallises out, while two-thirds of the sodium, transformed into carbonate, remain in solution.—A. Oppenheim reported on a mechanical method for preventing the most frequent cause of the incrustation or furring of steam boilers, lately patented by a large boiler-maker, M. Paukoch, in Landsberg. Instead of introducing the water directly into the boiler, he lets it run slowly through a wide tube passing through the boiler. Here, on being heated, the water deposits its carbonate of lime before it is admitted into the boiler. As the inner tube is not in contact with the fire, the deposit in it cannot produce the usual dangerous results.

PARIS

Academy of Sciences, Jan. 11.—M. M. Fremy in the chair.—The following papers were read:—On the mesaticephalic and brachycephalic fossil human races, by M. de Quatrefages, being the third part of the author's and M. Hamy's work on the skulls of the human races.—Report on M. Alph. Guérin's work, on the patho-genetic effect of fermentation products in surgical cases, and a new method of treatment of the amputated, by M. Gosselin.—MM. Bouilland and Pasteur then spoke in detail on the same subject; M. A. Trécul made some observations with regard to the production of vibriones and bacteria, in reference to the last subject.—Report on M. Halphen's memoir, concerning the important points of plane algebraic curves, by M. de la Gournerie.—On the existence of the integral in equations with partial derivatives, containing any number of functions and independent variables, by M. G. Darboux.—On the action of electrolytic oxygen on alcohol, by M. A. Renard; experiments made by the author, who exposed alcohol, to which about five per cent. of dilute sulphuric acid had been added, to an electric current from four to five Bunsen cells, and analysed the products after forty-eight hours' action: he found ethylic formiate and acetate, aldehyde, acetal, ethyl-sulphuric acid, and a new substance, ethylenic-monoethylate, which may be regarded as an acetal $\left.\begin{matrix}C_2H_5O\\C_2H_5O\end{matrix}\right\}C_2H_4$, in which one C_2H_5 is replaced by H, thus possessing the formula $\left.\begin{matrix}C_2H_5O\\HO\end{matrix}\right\}C_2H_4$.—On the "*seiches*" of Lake Leman, by F. A. Forel. *Seiches* are the sudden rises and falls in the level of this lake. The author gives an explanation of these phenomena and considers them constant and frequent in all larger lakes, and not rare and accidental as was believed hitherto.—A note by M. Martha-Becker, relating to his paper on ether and the origin of matter.—A note by M. H. de Kerikuff, with corrections for his communication on the velocity of light and the parallax of the sun.—A note by M. Poupelle, with regard to a system of electric danger signals to prevent railway collisions on a single line of rails.—On the reduction of equations with partial derivatives to ordinary differential equations, by M. W. de Maximovitch.—M. E. Flaquer communicates the observations and calculations made by the French Commission for the measuring of the arc of meridian between Barcelona and the Balearic Isles.—M. Lemonnier gives some new theories with regard to equations with common roots.—On the correction of Descartes' ovals, by M. A. Genocchi.—On some properties of the curvature of the surfaces, by M. Halphen.—On stratified light, by M. Neyreneuf.—On the specific rotative power of mannite, by M. G. Bouchardat; accounts of experiments made in M. Berthelot's laboratory.—M. P. Bouloumié communicates the results of his observations and researches on micro-organisms in suppurations, their influence on the healing of wounds, and the different means to prevent their development.—On white globules in the blood-vessels of the spleen, by MM. Tarchanoff and A. Swaen.—On the habits of a remarkable serpent of Cochin China: *Herpeton tentaculatum*, by M. A. Morice.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—On the Recent Progress and Present State of Systematic Botany: George Bentham, F.R.S. (British Association).—Institution of Civil Engineers (Printed by Private Press).—Agricultural Gazette Almanack, 1875 (W. Richards).—Westminster Review, January 1875 (Trübner).—The Nágpúr Waterworks: James Forrest (Clowes and Sons).

FOREIGN.—Note sur un procédé pour donner ou pour rendre leur couleur rouge aux muscles Conservés dans l'alcool: Félix Plateau (F. Hayez, Bruxelles).—Un parasite de l'Heiropteres de Belgique:* Félix Plateau (Academie Royale de Belgique).—Die Lösung der wichtigsten probleme in der Natur: Johann Friedrich Lochner (E. H. Mayer, Leipzig).—Les Comètes: Amédée Guillémin (Paris, Hachette and Co.)—In Sachen Darwin's insbesondere Contra Wigand: Dr. Gustav Jaeger (Stuttgart, E. Schweigerbart)—Annuaire de l'Académie Royale des Sciences, des Lettres, et des beaux-Arts de Belgique, 1875 (Brussels, F. Hayez).—Third Annual Report of the Director of the Imperial Mint, Osaka, Japan. Year ending July 31, 1874 (*Hiogo News* Office).—Der Darwinismus und der Naturforschung Newtons und Cuviers: Dr. Albert Wigand (Brunswick, F. Vieweg und Sohn).

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DIARY OF SOCIETIES.

London

THURSDAY, January 21.

Royal Society, at 8.30.—On the Origin and Mechanism of Production of the Prismatic (or Columnar) Structure of Basalt: R. Mallet, F.R.S.—On the Anatomy of the Connective Tissues: Dr. Thin.

Linnean Society, at 8.—On the Pathology of Oak-Galls, &c.: Dr. Hollis.—On the Nature of several Atolls in the South Pacific: Rev. T. Powell.—Papers on the Botany and Entomology of the *Challenger*.

Society of Antiquaries, at 8.30.—Further Notes on St. Hugh's Work in Lincoln Cathedral: J. H. Parker, C.B., F.S.A, and Sir G. G. Scott, R.A, F.S A.

Royal Institution, at 3.—Physical Geography: Prof. P. M. Duncan.

London Institution, at 7.—Early Inhabitants of England: Prof. Rolleston, F.R.S.

FRIDAY, January 22.

Royal Institution, at 9.—Wild Flowers and Insects: Sir John Lubbock, Bart, F.R.S.

Quekett Microscopical Club, at 8.—On the Aquarium as a field for Microscopical Research: T. C. White.

Society of Arts, at 8.—Indian Section; Opening Address: Sir George Campbell.

SATURDAY, January 23.

Royal Institution, at 3.—Beethoven: Mr. Dannreuther.

SUNDAY, January 24.

Sunday Lecture Society, at 4.—Some recent developments of the Theory of Volcanic Phenomena: Prof. A. H. Green.

MONDAY, January 25.

Geographical Society, at 8.30.

Entomological Society, at 7.

Society of Arts, at 8.—Alcohol, its Action and Use: Dr. B. W. Richardson, F.R.S.

London Institution, at 5.—Cremation: Mr. Armytage Bakewell.

TUESDAY, January 26.

Anthropological Institute, at 8.—Anniversary.

Royal Institution, at 3.—Pedigree of the Animal Kingdom; E. Ray Lankester.

West London Scientific Association, at 8.—Free Motion in Plants: G. S. Boulger.

WEDNESDAY, January 27.

Geological Society, at 8.

Royal Society of Literature, at 8.—On a Greek Inscription found at Ilium Novum in the Troad: Percy Gardner.

Society of Arts, at 8.

Institution of Civil Engineers, at 8.

THURSDAY, January 28.

Royal Institution, at 3.—Physical Geography: Prof. P. M. Duncan.

London Institution, at 7.—First Musical Lecture: Prof. Ella.

Torquay

MONDAY, January 25.

Natural History Society, at 12, noon.—Curiosities of Animal Life: Dr. C. Paget Blake.

Leeds

TUESDAY, January 26.

Naturalists' Field Club, at 8.—Organisation of *Daphnea pulex*: Thos. Tate.

Manchester

TUESDAY, January 26.

Geological Society, at 3.

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Professor FRANKLAND, D.C.L. F.R.S., will commence a Course of THIRTY LECTURES on ORGANIC CHEMISTRY at the New Buildings, Exhibition Road, South Kensington, on WEDNESDAY NEXT, the 20th of January, at 10 o'clock, to be continued on each succeeding Friday, Monday, and Wednesday, at the same hour. Fee, £3; to those who have attended the previous Course, £2.

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THURSDAY, JANUARY 14, 1875

THE APPROACHING ECLIPSE OF THE SUN

THE energetic action of the Council of the Royal Society, and the wise liberality of the present Government in matters connected with scientific investigation, have saved us from what would have been little short of a national disgrace.

If all goes well, the approaching eclipse of the Sun —during which, as stated by Mr. Hind, better opportunities for the observation of totality will be afforded than are likely to be again offered before the close of the present century—will be observed by English parties in Siam, and either in Burmah or in some island in the Bay of Bengal.

The work to be done, as determined by the Council of the Royal Society, and the investigations which have led up to it and render it of so great an importance, have been stated in Monday's *Times* in an article which enters so fully into the problem, that we take the following extracts from it:—

"In 1860, Mr. De la Rue, a member of the Astronomer Royal's Expedition, and Father Secchi, a delegate of the Italian Government, were enabled, by the photographs of the eclipsed Sun, which were then taken for the first time, to place beyond all doubt that the strange red prominences seen round the dark body of the Moon at the moment of total eclipse really belonged to the Sun's atmosphere. This was a fine achievement, for it settled a point which had been in debate for a century and a half. Important though it was, however, it was fairly dwarfed by the results of the expeditions sent by the Indian, French, German, and Austrian Governments to observe the eclipse of 1868 in India—dwarfed because in the meantime an instrument had been placed in the hands of the astronomer of a perfectly new kind of power. It was no longer a question of place and shape, but of material. Janssen, Tennant, Pogson, Weiss, and many others observed the eclipse with the spectroscope, and its story was that the prominences which in 1860 had been proved to belong to the Sun really consisted of a glowing gas, or a mixture of such gases. But the spectroscope was not of use only during eclipses. Before 1868 Kirchhoff by its means had stated the approximate composition of the Sun's atmosphere, taken as a whole; and immediately after the eclipse of that year it was found that by its aid the brightest part of the Sun's atmosphere, to which alone up to this time attention had been directed, could be seen without an eclipse at all. Indeed, we were soon told that outside the bright round disc that we see there was an evelope of glowing hydrogen gas, to which envelope the name of chromosphere was given, and into which are frequently injected from below magnesium and sodium, and, more rarely, iron and the other heavy metals. Here, then, we were enabled roughly to sort out into strata the various substances already detected by Kirchhoff; that is, it was established that the gases and vapours were not all mixed up together, but that the lightest, such as hydrogen, magnesium, and sodium, were generally at top, and that, as the others were shot up from time to time, and some of them more frequently than others, some of them were, as a rule, located lower down in the solar atmosphere than the others.

"The eclipse of 1869 the Americans had all to themselves, and splendid use they made of it. It has been well said that the line of totality which swept across the United States was one continuous observatory. In this eclipse the halo of light outside the prominence-envelope was the subject of special inquiry, and now this was photographed, as the prominences themselves had been in 1860. At the same time that this was done it was established that there was some other substance lying even outside the hydrogen.

"The eclipse of the next year, 1870, was best seen in different parts of the Mediterranean. The English Government, applied to by the Royal and Astronomical Societies, at once supplied the requisite funds and ships, and sent three parties; the United States Government sent an equal number; and the French one party, the Spanish and Italian astronomers observing locally. Further facts were obtained of great value; but the weather was not good, and the true nature of the corona was not considered to be finally established. Another appeal was therefore made to the Government in 1871 by the Presidents of the British Association, the Royal Society, and the Astronomical Society combined, to observe the eclipse of that year in India. The Government responded with a remarkable promptitude, granting everything that was required. The Indian Government not only had strong parties of their own, but largely aided the observers sent out from England; and the French Government were again represented by the illustrious Janssen, who had made his exit from beleaguered Paris in a balloon to observe the phenomenon. The Dutch Government had an expedition in Java. The combination of the results of the parties, most of whom had splendid weather, led to the following most important conclusions:—

"First, the corona was now at last photographed, under nearly the same instrumental conditions, from three different places, and the exact similarity of the pictures proved beyond all doubt that part of the corona was a solar appendage. The size of the Sun was enormously increased by this result. Secondly, evidence was obtained rendering it extremely probable that the light of the outer parts of the true solar corona, or *coronal atmosphere*, as Janssen proposed to call it, was stronger in the violet and ultra-violet parts of the spectrum than elsewhere. Thirdly, it was proved that for some distance above the hydrogen envelope, as seen without an eclipse, less bright hydrogen existed. The so-called chromosphere, therefore, was a layer of brighter hydrogen and other vapours. Other results were obtained, but the above are those on which we wish to lay the greatest stress, for reasons we now proceed to state.

"Since the eclipse of 1871 the every-day observations of the Sun and of his lower atmosphere (the chromosphere), which can be rendered visible by the spectroscope, have gone on with great vigour, especially in Italy. A special study of the chromosphere has been made at the expense of the United States Government, at an elevation of some 9,000 feet, on the Rocky Mountains; and extensive laboratory researches have been undertaken with the view of enabling us to understand better the various phenomena observed. We shall now only refer to the two latter branches of the work. Prof. Young, on the Rocky Mountains, in the clear air at so great a height, saw that the chromosphere was much more complicated than it appears to those who observe in the plains. Among other things, he found that the vapour of the metal calcium, the principal characteristic lines of which require perfect atmospheric conditions to enable us to see them, was very often present along with magnesium, but his observation left it doubtful which vapour extended highest generally. The laboratory experiments proved that, in the case of any one metal present in the Sun, the metal behaves exactly the same in the Sun's atmosphere as it does when driven into vapour by the passage of the electric current between the carbon poles of an electric lamp. At the greatest distance from the poles the spectrum of the vapour is the simplest (single-lined), in the core of the arc it is complex (many-lined). Now, in the case of some of the elements present in the Sun, we have a spectrum as complete as that we get in the core of the arc, in others only a line or two, so far as we know at present. In fact, we have hydrogen and the metals of the alkalis and alkaline earths and the metals of the iron class with almost complete spectra on the one hand, and on the other only a few lines indicating the presence of such metals as zinc and lead.

"Nor is this all. A most diligent search has been made for metals of the tungsten, antimony, silver, and gold classes among the metals, and entirely without success. Dealing, however, with the metals the record of which is most obvious in the solar spectrum, hydrogen, magnesium, calcium, sodium, and the metals of the iron group, the order we have given is not only the order in which they would be met by a body entering into the solar atmosphere, but it is the order of the old atomic weights. Further, although it is true that at present we do not know much about the spectra of the stars, we do know that the stars with the simplest spectra are stars which only give clear indications of hydrogen, or hydrogen and magnesium, or hydrogen, magnesium, sodium, and so on. A star as it gets gradually older may apparently give us a spectrum belonging to a gradually increasing depth of the solar atmosphere as it exists at this moment.

"So far we have said nothing about metalloids; that is, those elementary bodies, such as oxygen, carbon, nitrogen, sulphur, and the like, which make up more than half of the parts of our planet most easily got at. Of metalloids in the chromosphere none have been detected, but a year ago a paper was presented to the Royal Society pointing out that their record would appear not to be entirely absent from the solar spectrum; in fact, that we have exactly such a record as we should expect if this large class of bodies existed in a comparatively cool part of the atmosphere at some height above the hotter lower strata. It was also shown that, granting this, we could explain the various classes of stars in the heavens by supposing that as a star got older and colder the metalloids were enabled to exist lower down in the atmosphere, and thus to change the character of the spectra of stars bright and hot into that associated with those which are dim and possibly colder, until at last the metalloidal rain, so to speak, falling on the metals below, gives the material of a future crust. It will be seen, then, that the work since 1871 has been assuming more and more a chemical character, and associated with this are physical questions of the greatest interest, not only bearing on the kinetic theory of gases, but which may eventually help us to follow more intelligently than we can now the matter of a nebula till it forms part of the cooled crust of a planet.

"The present line of inquiry, then, is to determine the chemical nature of a section of the Sun's atmosphere reaching from the photosphere to the extreme limit of the corona, some hundreds of thousands of miles away. This with the old conditions of observation, would have been a hopeless task to accomplish. But, side by side with the results to which we have drawn attention, new methods of investigation have been introduced, and among these the development of spectrum photography deserves first mention. The spectrum of the corona can now be photographed with the same ease as the prominences were photographed in 1860, and if such photographs can be obtained, it is certain that the work of four minutes will in all probability be more valuable than laboratory work extending over as many years. But even spectrum photography would not have been applicable under the best conditions unless side by side with it an instrument had been introduced which is destined to effect a great revolution in astronomical observation. In the Siderostat we have an instrument suggested by Hooke and perfected by Foucault, which enables us to do away with telescope stands and their equatorial mountings altogether. This is effected by moving a large, perfectly plain mirror in front of the object glass of a telescope, the telescope itself being horizontal and at rest. This arrangement permits of spectroscopes and photographic apparatus being attached to the eye-piece end of the telescope of even greater dimensions than the telescope itself. The special and novel method of attack to which Mr. De la Rue referred as having been suggested to the Council of the Royal Society can now be guessed by our readers; and unless we have missed the mark altogether, it should now be seen that the work of the proposed expedition of this year is the fruit and crown of the work begun in 1860 and carried on by the English and other civilised Governments since that time. . . . ."

We have little to add to the foregoing, except that it appears to us a sad thing, and little to the credit of the leaders of astronomy in England, that such strong arguments should have to be put forward at all in favour of eclipse observations. *Every total eclipse of the Sun ought to be observed as a piece of the national business with as great a regularity as the transit of the Moon over the meridian of Greenwich.* Nay, we may go further, and say with *greater* regularity; for we know something about the motion of the Moon, and we can predict her place with some accuracy, but he would be a bold man who would predict the shape and condition of the Sun's surroundings in the forthcoming eclipse. Practical men might possibly urge the greater utility of one kind of observation, but a man of science who does this is to our mind not a true man of science at all.

Mr. Hind has sent us the following most valuable information regarding the actual conditions of observation, referring at somewhat greater length to Siam, whither English astronomers are invited by the King of Siam.

"Although the course of the central line in this eclipse is mainly a sea-track, yet in its passage from the Nicobar Islands, in the Bay of Bengal, to Siam, better opportunities for the observation of totality will be afforded than are likely to be again offered before the close of the present century.

"Adopting the elements of the *Nautical Almanac*, in which the place and hourly motions of the moon are derived from Hansen's Tables, I find the following points upon the central line:—

Greenwich Mean Time.			Longitude East.		Latitude North.		Sun's Altitude.	
H.	M.	S.	°	′	°	′	°	′
19	8	0	92	36·9	7	34·2	71	8
19	14	0	94	20·2	9	1·6	67	51
19	23	0	97	9·5	11	10·4	62	38
19	26	0	98	9·9	11	52·7	60	51
19	28	30	99	2·5	12	27·3	59	18
19	32	0	100	19·7	13	15·9	57	6

"If we lay down these points on the Admiralty Charts of the Bay of Bengal and Province of Tenasserim (British Burmah), we find the central line passing a little north of Kaikul, in the Island of Camorta, Nicobars, and on making a direct calculation for Kaikul, totality is found to commence at 1h. 21m. 38s. local mean time, and to continue 4m. 27s., the sun being at an altitude of about 70°. I take the position of Kaikul, 6h. 13m. 31s. E. and 8° 11′·8 N. The central eclipse, passing from the Nicobars, traverses Bentinck Island, where the maximum duration of totality is 4m. 17s., and runs between Mergui and Tenasserim, rather nearer to the former place than to the latter. By direct calculations I find

Totality begins at Mergui at. . . . 2h. om. 6s. local time.
Duration ... ... 4m. 6s.
Sun's altitude ... ... 61°

Totality begins at Tenasserim at 2h. 2m. 7s. local time.
Duration ... ... 3m. 57s.
Sun's altitude ... ... 60°

Nearly midway between the above places, or where a "Conical Peak" is marked on the Admiralty Chart, the total eclipse continues 4m. 14s.

"Bangkok (Siam) will be found to lie rather north of the central line. The circumstances of the eclipse at this point are as follows (long. 6h. 42m. 6s. E.; lat 13° 42′5″ N.)

"The partial eclipse begins at oh. 51m. 6s. mean time at Bangkok, 134° from the north point towards the west, and 168° from the vertex eastward, for *direct* image; the sun at an altitude of 76°. The total eclipse begins at 2h. 13m. 7s. and continues 3m. 54s., the sun about 57° high, and the partial phase ends at 3h. 33m.

"The invitation extended to British and other astronomers by the King of Siam, to observe this interesting and important phenomenon within his dominions, may be expected to bring together a number of competent observers in the vicinity of Bangkok; and in selecting localities for astronomical stations, it must be very desirable to be enabled to form some idea of the extent of error to which the predicted track of the central line may be subject. On this account I have made a further direct calculation for the Siamese capital, taking the moon's position from the American Ephemeris, in which the Tables of Prof. Peirce are employed. With elements thus modified, the partial phase is found to commence at oh. 50m. 42s., or 24 seconds only earlier than by Hansen's Tables; totality begins at 2h. 13m. 32s., and continues 3m. 59s. Generally I may remark that between the longitudes of the Nicobars and Siam, the track of central line by the American Tables has about five minutes greater latitude than that given by Hansen's Tables.

"(For any point in Siam in the neighbourhood of Bangkok, the *Greenwich* time of commencement of the partial eclipse will be given closely by the following formula :—

$$
\begin{aligned}
\text{Cos. } w &= -0\cdot08471-[0\cdot12053] \text{ sin. } l+[0.12430] \text{ cos. } l, \text{ cos } (L-172^{\circ}\ 10'\cdot1)\\
t &= 18\text{h. } 55\text{m. } 58\text{s.}-[3\cdot71146] \text{ sin. } w+[3\cdot83098] \text{ sin. } l\\
&\qquad -[3\ 83692] \text{ cos. } l, \text{ cos. } (L-4^{\circ}\ 14'\cdot5)
\end{aligned}
$$

The *Greenwich* mean time of beginning and ending of totality may be found from

$$
\begin{aligned}
\text{Cos } w &= -17\cdot5228-[1\cdot74616] \text{ sin. } l+[1\cdot68499] \text{ cos. } l, \text{ cos. } (L-150^{\circ}\ 25'\cdot5)\\
t &= 18\text{h. } 17\text{m. } 58\cdot5\text{s. } \mp [2\cdot09477] \text{ sin. } w+[3\cdot77348] \text{ sin. } l\\
&\qquad -[3\cdot84594] \text{ cos. } l, \text{ cos. } (L+16^{\circ}\ 32'\cdot8).
\end{aligned}
$$

"In the above formulæ *L* expresses the east longitude of the point from Greenwich, taken positive; *l* is its geocentric latitude, and the quantities within the square brackets are logarithms. Upper sign for beginning of totality, lower sign for ending.)

"It has been stated above that the eclipse of next April may probably be the most favourable for observation that can take place during the present century. In the eclipse of 1878, July 29, the duration of totality is shorter, and the same is the case in the eclipses of 1882, 1887, 1900, &c. . In the eclipse of 1886, August 29, the only easily accessible and favourable station appears to be the Island of Grenada, in the West Indies, where the duration of total eclipse is 3m. 15s., commencing at 7h. 10m. A.M. local time, with the sun at an altitude of 20°; thence the course of the central line is over the North and South Atlantic Oceans, to a point on the African coast north of St. Philip de Benguela. In the eclipse of 1892, April 26, the central line appears to have a sea-track through nearly its whole extent, if indeed it touches land at any point, which requires a more precise computation than I have yet made to determine. The eclipse of 1893, April 16, is the only one that can compare favourably, as regards length of totality and track, with that of the present year: at a point in the vicinity of Ceara, in the Brazils, the duration of total eclipse is 4m. 44s. with the sun at an altitude of 76°."

We may conclude our article by stating that the observations for which the Council of the Royal Society have obtained a promise of a grant in aid amounting to 1,000*l.* will be limited to photographing the spectra of the chromosphere and coronal atmosphere.

For this purpose a siderostat has been placed at the disposal of the Royal Society, and another will be ready in time. These instruments have been made by Messrs. Cooke and Sons, of York, who have in some respects, with their usual skill, improved upon Foucault's model. As an instance of international courtesy which must not be unrecorded, we may state that M. Leverrier would have placed the original instrument devised by Foucault himself, and now at the Paris Observatory, at the disposal of the Royal Society, had it not been constructed solely for the latitude of Paris.

Besides siderostats, it is proposed that equatoreals shall be sent out also, provided with apparatus for spectrum photography, quartz prisms and lenses being generally employed.

The Secretary of State for India (Lord Salisbury), the Viceroy of India, and the Admiralty officials are all hearty in their co-operation. It is hoped that Col. Tennant and a strong staff of assistants will also be on the scene of action.

Although the time is short, then, we may fairly hope that good work will be done. Of this we may be assured, that whether the observers be many or few, whether the weather be good or bad—and General Strachey considers the chances all that can be wished for—the action of the Royal Society and of the Government will redound to the credit of English science, and a bright page may be added to the scientific annals of our time.

EDITOR

COUNT RUMFORD'S COMPLETE WORKS

The Complete Works of Count Rumford. (Published by the American Academy of Arts and Sciences.)

THE American Academy of Arts and Sciences is doing good service and teaching the Old World a sound practical lesson by undertaking the publication of such a work as this. The question of what form should be given to the monument of a great man is often discussed, and fairly admits of much debating; but when the benefactor of humanity whose memory is to be preserved is one who has done the high service of extending the boundaries of science, we may safely venture to affirm that whatever *other* monuments may be erected, the *first* should be a complete and carefully compiled record of all his researches. The demand for this arises from the manner in which the results of original scientific work are usually communicated to the world, *i.e.* in the form of papers read before learned societies or contributed to magazines, or published as pamphlets, and thus scattered far and wide and liable to be forgotten or even altogether lost. Such a publication should precede all other forms of memorial on the simple principle that strict justice should precede generosity. The object being to perpetuate and honour the memory of such a man, the first step should be to do *justice* to his memory, and this cannot be done unless his works are collected in an available and presentable form. The most perfect of monumental epitaphs is Sir Christopher Wren's in St. Paul's Cathedral—

> "Lector, si monumentum requiris, circumspice."

A handsomely printed record of the life-work of any original investigator might bear a similar inscription. The justice of such an epitaph would be absolutely complete.

That Count Rumford himself took this view of the matter is evident from the fact that on recovering from the illness which in 1793-94 nearly finished his career, he left Bavaria and came to London in September 1795 for the purpose of publishing a collection of these same essays which the American Academy have now reprinted, and that he left London in 1802 when their publication was completed. His narrow escape from death had evidently suggested the necessity of losing no more time in thus doing justice to his own memory.

But it is not every scientific investigator who finds an appreciative monarch, like the Elector of Bavaria, willing to reward so munificently the services of intellect; there are but few who can afford to indulge in the expensive luxury of printing books which the uneducated millions and the ill-educated thousands are equally incapable of appreciating. The professional publisher is prohibited from undertaking such work, from the simple fact that much activity in that direction would land him in the Bankruptcy Court. Here, then, is a clear demand for uncommercial effort, if the memory of great men is to be preserved and the full advantages of their labour are to be reaped by their fellow-creatures.

We should do well here in England by at once commencing a great national effort in this direction. Local patriotism would be appropriately directed by starting the subscription for a republication fund in every town or village which has the honour of having given birth to a worthy worker in science; and our learned societies might carry out the work as the American Academy has done in this case. Birmingham has done well in erecting the noble statue of Priestley that fitly decorates the approach to the Birmingham and Midland Institute; but the student who admires the sculptured presentation of the great philosopher performing his great experiment has considerable difficulty in finding the full original record of this scientific exploit. How very interesting to the general student, either of science or of human nature, would be a complete collection of all the far-scattered and diverse works of Priestley's powerful and wide-grasping intellect! At present they are practically buried. The same may be said of the majority of the inductive philosophers, from Horrocks, Gilbert, and Galileo, down to the name on the latest scientific obituary. Such collections of the works of our great philosophers would be a worthy complement to the Royal Society's invaluable index of scientific papers.

The following list of the subjects treated in the three volumes already published sufficiently indicates the variety of Rumford's work :—

A Method of determining the Velocity of Projectiles; Experiments to determine the Force of fired Gunpowder; Experiments with Cannon, and Improvements in Field Artillery; The Production of Air from Water; The Quantities of Moisture absorbed from the Air by various substances; The Propagation of Heat in Fluids; The Final Cause of the Saltness of the Sea; Chemical Affinity and Solution, and the Mechanical Principle of Animal Life; The Propagation of Heat in various substances; The Source of the Heat which is excited by Friction; An Inquiry into the Weight ascribed to Heat; The Nature of Heat, and the Mode of its Communication; Experimental Investigations concerning Heat; Reflections on Heat; Historical Review of the various Experiments of the Author on the subject of Heat; Experiments and Observations on the Cooling of Liquids in Vessels of Porcelain, gilded and not gilded; Account of a curious Phenomenon observed on the Glaciers of Chamouni; New Experiments on the Temperature of Water at its Maximum Density; The Propagation of Heat in Liquids; Adhesion of the Particles of Water to each other; The slow Progress of the Spontaneous Mixture of Liquids; The Use of Steam as a vehicle for transporting Heat; The Means of increasing the Quantities of Heat obtained in the Combustion of Fuel; Description of a New Boiler; The Use of the Heat of Steam in the making of Soap; Experiments on Wood and Charcoal; Heat developed in the Combustion and in the Condensation of Vapours; The Capacity for Heat of various Liquids; The Structure of Wood, &c.; Chimney Fireplaces; the Management of Fire, and the Economy of Fuel; The Construction of Kitchen Fireplaces and Kitchen Utensils; The various Processes of Cookery, and Proposals for improving that most useful art; The Management of Fires in closed Fireplaces.

One remarkable feature of Count Rumford's papers is their simplicity and clearness. They are all readable, to the least initiated in scientific technicalities. There is no pedantry, no vain display of unnecessary formulæ; but, on the contrary, every page displays the clear and purely scientific intellect of the writer. It matters not whether he is discussing the proper shape of a saucepan lid, the flavouring properties of a red herring, or the deepest mysteries of molecular force; whether he describes his method of eating a plate of hot pudding, or of reorganising and commanding the Bavarian army—the same thoroughness and simplicity of pure inductive and deductive reasoning prevails. He seems to have been incapable of thinking of any subject other than systematically and scientifically; and to this fixed habit of mind his marvellous success in the solution of the most difficult social and military problems is clearly traceable. His last effort, the essay on "The Nature and Effects of Order," upon which he laboured so long during the last years of his fading life, and which the feebleness of his over-tired intellect prevented him from finishing, was apparently intended as a vindication of his peculiarly strict and systematic method of doing everything, which was so miserably misunderstood by his eulogist Cuvier, his intensely French wife, and the Frenchmen by whom he was surrounded and ridiculed during his latter days. To do such work as Rumford achieved, and do it all so coolly without any sentimental flourishes, without drums or flags or processions, or trumpets, or inaugurations, was to them quite incomprehensible, and hence their misrepresentation of his work and character, when they tell us that he looked upon mankind merely as objects of experiment, and not with any philanthropic feeling, and that "il ne s'agissait que de nourrir les ouvriers assez bien pour entretenir cher eux la force musculaire des membres." Those portions of his essays in which he describes the work done at the "House of Industry" in Munich utterly refute these mistaken views of Rumford's character.

I have read nothing more humiliating in reference to the still remaining magnitude of popular ignorance of the merest rudiments of physical science than some of these essays. Take as an example this passage on page 177 of vol. ii. "The waste of fuel in culinary processes, which arises from making fluids boil *unnecessarily*, or when nothing more would be necessary than to keep them *boiling hot*, is enormous. I have no doubt but that much more than half the fuel used in all our kitchens, public and private, in the whole world, is wasted precisely in this manner." Again, he tells all the world that "nothing is so ill-judged as most of those attempts that are so frequently made by ignorant projectors *to force the same fire to perform different services at the same time.* The heat generated in the combustion of fuel *is a given quantity*, and the more *directly* it is applied to the object on which it is employed so much the better, for less of it will escape or be lost on the way; and what is taken away on one side for a particular purpose can produce no effect whatever on the other side where it is not."

These, and quite a multitude of similarly simple and obvious applications of the elementary laws of heat, were not only expounded but practically applied by Rumford eighty or ninety years ago, and we are still blundering on and blindly violating them. Every laundry is still filled with the steam of wastefully boiling coppers, and almost every saucepan in the United Kingdom and elsewhere is wastefully used for the unnecessary distillation of water, not one cook in 500 knowing that water is no hotter when it boils violently than when it "simmers" gently. Nine-tenths of the ranges exhibited at the last Exhibition of South Kensington were constructed in direct violation of the simple and obvious principles above stated, and our ironmongers still persist in making "kitcheners," "ranges," &c., with the fire in the middle, the oven on one side, and a boiler on the other, or even with ovens on both sides; instead of placing the fire on one side, the oven next, and boiler beyond, to utilise residual heat. In most of our best English houses a range capable of cooking for a dinner party of thirty or forty people is kept going to supply water for a tumbler of toddy, although Rumford demonstrated again and again the vast economy and convenience of having several fires in every establishment where the demands for cooking are variable, and his essays give descriptions and drawings of how these fires should be arranged.

It must be remembered that Rumford was no mere theoretical writer or lecturer, but he practically carried out on large and small scale every principle he expounds. He cooked for thousands and tens of thousands in his military kitchens, his House of Industry, in private houses, at the Foundling Hospital in London, at public institutions in Dublin, Edinburgh, &c.; and in these practical demonstrations weighed his fuel, registered its consumption, and published the results.

Thus, at the Foundling Hospital he roasted 112 lbs. of beef with 22 lbs. of coal, the residual heat from the roaster going on to the boiler. In the public kitchen at Munich, where his arrangements were fully carried out, he frequently—as certified by the Colonel and Councillor of War—prepared the ordinary hot dinner for one thousand persons, and "the expense for fuel has not amounted to quite twelve kreutzers" (less than 4½*d.*, or one-fiftieth of a farthing for each person). It must be remembered, in reference to this, that Rumford's soup requires five hours' boiling, or rather heating at the boiling-point.

I have little doubt that the merited failure of all the recent competitors for the Society of Arts' prize was due to the absence of scientific knowledge, and of that systematic inductive method of proceeding by the aid of which Rumford wedded theory to practice, and brought forth such important results. His researches on the "Propagation of Heat in Fluids," upon which our present knowledge of the phenomena of the convection of heat is mainly founded, were suggested by burning his mouth with a spoonful of thick rice soup, and were further elaborated in order to determine the best material for soldiers' clothing. His celebrated demonstration of the immateriality of heat was in like manner a result of cannon-boring. Every essay in these three volumes supply similar illustrations of the action and reaction of theory and practice upon each other, and their mutual development thereby.

One of the most curious and least-known of his speculative efforts is that upon "the mechanical principle of animal life." They bear upon many of the molecular speculations now occupying so much attention, and are sufficiently interesting to demand full quotation of the following essential paragraphs:—

"Suppose an open vessel—as a common glass tumbler, for instance—containing a piece of money, a small pebble, or any other small solid opaque body, to be filled with water and exposed in a window, or elsewhere, to the action of the sun's rays. As a ray of light cannot fail to generate heat when and where it is stopped or absorbed, the rays, which, entering the water and passing through it, impinge against the small solid opaque body at the bottom of the vessel, and are *there absorbed*, must necessarily generate a certain quantity of heat, a part of which will penetrate into the interior parts of the solid, and a part of it will be communicated to those colder particles of the water which repose on its surface.

"Let us suppose the quantity of heat so communicated to one of the integrant particles of the water to be so small that its effect in diminishing the specific gravity of the particle is but just sufficient to cause it to move upwards in the mass of the liquid with the very smallest degree of velocity that would be perceptible to our organs of sight were the particle in motion large enough to be visible. This would be at the rate of about *one hundredth part of an inch* in a second.

"This velocity, though it appears to be slow in the extreme when we compare it with those motions that we perceive among various bodies by which we are surrounded, yet we shall be surprised when we find what a rapid succession of events it is capable of producing.

"If we suppose the diameter of the integrant particles or *molecules* of water to be *one-millionth part of an inch* (and it is highly probable that they are even less), in that case it is most certain that an individual particle, moving in a quiescent part of that fluid with the velocity in question, would run through a space equal to *ten thousand times the length of its diameter in one second*, and consequently would come into contact with at least *six hundred thousand* different particles of water in that time.

"Hence it appears how inconceivably short the time must be that an individual particle, in motion, of any fluid can remain in contact with any other individual particle, not in motion, against which it strikes in its progress, however slow that progress may appear to us to be through the quiescent mass of the fluid!

"Supposing the contact to last as long as the moving particle employs in passing through a space equal to the length of its diameter—which is evidently all that is possible, and more than is probable—then, in the case just stated, the contact could not last longer than $\frac{1}{10000}$ part of a second! This is the time which the cannon bullet, flying with its greatest velocity (that of 1,600 ft. per second), would employ in advancing two inches.

"If the cannon bullet be a *nine-pounder*, its diameter will be four inches, and if it move with a velocity of 1,600 feet in a second, it will pass through a space just equal to 4,800 times the length of its diameter in one second. But we have seen that a particle of water moving 100th of an inch in a second actually passes through a space equal to 10,000 times the length of its diameter in that time. Hence it appears that *the velocity with which the moving body quits the space it occupies* is more than twice as great in the particle of water as in the cannon bullet!"

I am sorry that space does not permit further quotation of this essay, in which the author goes on to show that inequality of fluid temperature is one of the leading phenomena of animal life; that respiration raises the heat in one part, while insensible perspiration cools another; that stimulation of all kinds is accompanied with disturbance of temperature and the consequent motion of particles, which he regards as the life of fluids.

Of course it is not supposed that Rumford, by these ingenious speculations, supplies any mechanical solution of the mystery of *conscious* vitality, but his suggestions have the merit of showing that a vast amount of molecular activity is a demonstrable result of simple well-known facts. He obtains this activity without invoking the aid of those profound assumptions in which the brilliant imaginations of modern mathematicians so luxuriously revel when they reason upon the vibrations, gyrations, &c., of the component particles of interatomic atmospheres.

In spite of all the progress we have made in physical science, these essays, written for the most part during the last century, contain a great deal that is still suggestive and worthy of thoughtful reading both by popular students and experts in physical and social science. This is especially the case in the essay on "The Propagation of Heat in Fluids," reprinted in vol. i. of this work. Many of the conclusions and speculations are now demonstrably erroneous, but some of the suggestions—more particularly those in chap. iii. on the Chemical Action of Light—are worthy of far more attention and investigation than they have yet received. They are avowedly very bold, but the author tells us frankly that their temerity "has not been entirely without design;" that "philosophers may be *enticed* and they may be *provoked* to action," and that he has "endeavoured to use both these methods," even with conscious imprudence, for the purpose of exciting them to further investigation of the subjects for which he has such "passionate fondness."

It will be well if the republication of these essays contribute to the fulfilment of Rumford's enthusiastic wishes.

W. MATTIEU WILLIAMS

THE SILKWORM COCOON

Le Cocon de Soie. Histoire de ses transformations, description des races civilisées et rustiques, production et distribution géographiques, maladies des vers a soie, physiologie du cocon et du fil du soie. Deuxième Edition. (Paris: J. Rothschild, 1875.)

WE have received an advance copy of M. E. Duseigneur-Kléber's monograph, "Le Cocon de Soie," dated for 1875, the get-up of which is calculated at once to arrest attention and excite interest. The 248 quarto pages of clearly printed letterpress containing his information, admirably arranged in methodic form, are accompanied by thirty-seven plates executed in photo-typography, and a map of the world indicating the localities where silkworms are cultivated. Twenty-eight of the plates are devoted to the illustration of the different types of cocoons from different countries, of which as many as 195 are figured from photographs.

Such a work was, he says, quite impossible twenty years ago, and it is only in consequence of diseases that it is possible now. Each district prided itself on the silk it produced, and did not trouble to know what other countries were doing, until the enfeeblement of some and the destruction of other types by disease compelled growers to seek fresh types from a distance, and thus accumulated the information which M. Duseigneur-Kléber has compiled and presented in this attractive form. Many of the types he thinks will probably not be again met with in cultivation, and it is only through noticing and recording facts as they came under his notice during a series of years that his information has been obtained. Looking to the past, he finds that from 1700 the years of disease were 1702, 1720, 1750, 1787, but the chroniclers give no intimation of the character of the disease. In 1810 the "plague" was described by M. Paroletti. The affected worm exhibited small spots all over its body, which were gangrenous, and appeared to be caused by the same disease now known as "Muscardine."

Among the practical points noticed in the first section of the work are the following: That the red or black mulberry produces more vigorous worms than the white; that the old notion of selecting bright-coloured cocoons for breeding has given place to the belief that dull yellow are the best; that the practice of limiting the time of copulation of moths is injurious; that while the worms are making their cocoons, the ventilation of the buildings, too often neglected, is even more important than warmth. The symptoms of the disease known as Pebrine are detailed, but its cause seems to be not known. That its recurrence coincides with unusually wet and cold seasons is established, but whether it results from a parasitic vegetation whose germs are carried in the air is still a subject for experiment. When the external indications are well marked, the silk reservoir is found much diminished in volume. The spots which appear on the skin continue through successive moultings; the feet become atrophied: if the worm dies, the body dries up without putrefaction; if it lives on to metamorphosis the moth shows all the characters of hydropsy.

M. Duseigneur-Kléber has paid much attention to the method of work performed by the worms in the construction of their cocoons. A healthy worm (in disease they act irregularly) selects a suitable spot for its operations, where there is space for its whole body to move about, supporting itself generally by its two last feet only. Having carefully arranged from twig to twig the outline of its work, its movements quicken, and at the end of three hours the first outer layers of its nest are complete, and the sphere of operations is then limited. At the end of five or six hours the exact form of the cocoon is indicated, still remaining diaphanous and rarely coloured yellow. So far it is easy to watch the worm at work, and it is seen that it holds itself in a semicircle or curved like an S. After a little more work the cocoon loses its transparency, and begins to be coloured. The author, however, by methodically cutting into cocoons continued his observations, and found that the worms never stopped to repair the damages thus caused, but going on uninterruptedly, the layers formed within the cut layer rapidly covered the aperture. Remaining attached by its hind legs, a worm forms its layers in the shape of an 8, changing its position from time to time, generally moving but a short distance, though sometimes turning completely round and continuing on the opposite side of the cocoon. He calculates that, varying according to race, there are from thirty to forty different layers in a cocoon, and the time occupied in its construction is from three-and-a-half to four days. Whatever may be the condition of the outer layers, the innermost coat formed is of the finest thread, and the end towards which the head is turned is the tenderest, thus providing a soft and elastic cradle for its metamorphosis.

The book is especially intended for practical purposes, and contains information as to the outward appearance that may guide a dealer in purchasing cocoons, a special chapter being given to each kind of defect. Not only double cocoons, but cocoons in which three or even four worms have worked together, are mentioned.

In the enumeration of silk-rearing districts, besides the well-known localities of France, Italy, the Austrian Empire, China, and Japan, the following less known are among those mentioned:—California, Mexico, Guatemala, Peru, Brazil, Chili, the Argentine Republic, Algeria, and Armenia. In South America especially increased attention is being paid to silk-production, and it gives promise of becoming a very important industry.

OUR BOOK SHELF

The Straits of Malacca, Indo-China, and China; or, Ten Years' Travels, Adventures, and Residence Abroad. By J. Thomson, F.R.G.S. Illustrated. (London: Sampson Low and Co., 1875.)

Mr. Thomson's sojourn in the countries with which his book is concerned seems to have extended from 1862 onward, during which time he evidently had plenty of leisure to visit various places on the south-east and east of Asia, extending from Penang to Pekin. We can heartily recommend his modest work to anyone wishing to obtain a fair idea of the social life, scenery, and productions of the districts which he visited, and in which he usually sojourned for some time, including the Malay Peninsula, Siam, Cambodia, Hong Kong, Amoy, Pekin, and other coast-towns of China. He also sailed a considerable distance into the interior of China, up the Yang-tse-Kiang, and made a short walking tour into the interior of Formosa. Mr. Thomson put his eyes, his ears, and his camera (for he is an accomplished photographer) to excellent use, so that we do not know any work of the size that conveys a juster and fuller idea of the manners and customs of the various peoples whom he visited. Mr. Thomson makes no pretension to have travelled in the interests of science, but only to be a photographer and an observer of the ways of men. Nevertheless, throughout the work occasional jottings are introduced that may be of interest to the botanist and geologist. Among the very first pages he hazards some conjectures as to the cause of the love of brilliant colours among tropical men, birds, and flowers, which are evidence of some observation and thought. "Perhaps," he says, "our men of science might be able to tell us whether the heat of the oriental sun develops in flowering plants a craving for the absorption of certain colours of the solar spectrum, and for the reflection of others; whether, indeed, the electric affinities of plants in this way are affected by temperature. Can we, in the same way, account for the brilliant plumage of tropical birds, in which homogeneous red, yellow, and blue are very conspicuous, and also for the liking which uncultured Eastern races show for the reds, blues, and yellows."

Mr. Thomson gives some very interesting information about the Chinese, whom he found wherever he went, mingling as managers or factors in the life of every place, always bent on making money, and generally succeeding. He seems to have studied their ways intimately, and gives some very curious facts with regard to the powerful associations, or guilds, into which they band themselves everywhere. His visit to Siam, and the account of his intercourse with the King and other dignitaries, will be found entertaining as well as informing.

One of the most valuable chapters in the book, certainly the most interesting to archæologists and ethnologists, is Mr. Thomson's account of his visit, in 1866, to the magnificent ruins in Cambodia, probably the grandest, if not the most interesting ruins in the world. The illustrations to this part of the work will give the reader a fair idea of the nature of these ruins, their colossal and beautiful architecture, and their wonderful sculpture, giving evidence of a vigorous and high civilisation, the lapse or obliteration of which is one of the strangest events in the history of the world. We have much to learn yet about the history of these ruins and of the people of which they are almost the only remains. "A richer field for research," Mr. Thomson rightly says, "has never been laid open to those who take an interest in the great building races of the East, than that revealed by the discovery of the magnificent remains which the ancient Cambodians have left behind them." We may expect the French, who are the dominant European race in this quarter, to add considerably to our knowledge of these remains, and to clear up the mystery which lies around them. Indeed, the late unfortunate Lieut. Garnier, in his "Travels in Indo-China," has both with pen and pencil shed much new light on the subject.

To those who don't know much about Formosa and its strange inhabitants, savage and semi-civilised, Mr. Thomson's account of his tour in the island will be found of considerable interest. Appended is a list of the Diurnal Lepidoptera of Siam, collected by Mr. Thomson, and named by Mr. H. W. Bates, F.L.S. Altogether the book is a thoroughly creditable and, we believe, credible one, full of the most interesting information, and valuable for the considerable insight it gives into the life of

these Eastern Asiatics. The wood engravings, upwards of sixty, taken from the author's photographs and sketches, add much to the value of the volume.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Hoffmeyer's Weather Charts

I HAVE the honour to inform you that the issue of Capt. Hoffmeyer's daily charts of the weather from 63° E. to 60° W. longitude, and from 30° to 75° N. latitude, for the three months of last winter, are now complete. (See NATURE of June 25, 1874).

Capt. Hoffmeyer is anxious to know what chance there is of his being able to continue the publication. The number of copies already sold of the existing charts has not been sufficient to cover the expenses of production.

At the same time this Office has found that the rate of subscription (11*s.* per quarter) which it charges has fallen short of the cost, carriage, and postage of the existing charts.

I have therefore to request any gentlemen who are willing to subscribe to a future issue of the charts to send in their names to me as soon as convenient. The rate of subscription will be at least 12*s.* 6*d.* per quarter, and must necessarily be higher if the original cost of the charts at Copenhagen is raised above the price first named, viz., 4 francs per month.

Meteorological Office, Jan. 12 ROBERT H. SCOTT

A New Bird of Paradise from the Island of Waigeou, near New Guinea

I GOT to-day from Ternate the skins (♂ and ♀) of a Bird of Paradise from Waigeou, which came through natives into the hands of Mr. van Mounhenbroek there, who recognised it to be an undescribed species. He proposes to call it *Diphyllodes Guilhelmi* i.i., because no Bird of Paradise has yet been named after the King of the Netherlands, under whose sceptre the greater part of the region stands, where Birds of Paradise occur. It is known that two species from Australia are named respectively after the Queen of Great Britain and the Prince Consort, that three are named after naturalists, and that the others have names according to their external features. This new bird is highly interesting, because it stands in a conspicuous way between *Diphyllodes speciosa* and *Cicinnurus regius*, but more allied to the former, and at the same time bearing some characters of *Diphyllodes respublica;* therefore linking these species together in a similar way as it does *Paradisea raggiana* (one of D'Alberti's discoveries) with *P. sanguinea, apoda* and *minor*. I shall soon send (in the name of Mr. van M.) the description of the new bird to the Zoological Society of London, and intend to publish a coloured figure as soon as possible. But knowing the lively interest English ornithologists take in new discoveries in the group of the *Paradiseidæ*, I thought it advisable to give a short notice in your journal beforehand. A. B. MEYER

Dresden, Jan. 9

Chappell's "History of Music"

IN a review of my "History of Music," in NATURE, vol. xi. p. 123, your musical critic takes me to task for having cautioned English readers against certain new theories which are to be found in the works of the late F. J. Fétis and in the "Tonempfindungen" of Prof. Helmholtz. I think those cautions very necessary, and perhaps, when your critic has studied the subject, he may think so too; but in the meantime he bows down before such names, and cautions me that if Fétis were alive he "would not be in my shoes for a trifle."

I should rather object to change shoes with the critic, but I may remind him that he seems to have forgotten his obligations to the readers of NATURE. However diffident as to his qualification to controvert me, and therefore hoping for a second Fétis to arise, it was at least his duty to test each of us by the authorities which we quote, and to inform your readers of the result. He must know that two such opposite accounts cannot both be true, and therefore either the one or the other is not trustworthy. Fétis and I differ *toto cœlo*, even to the scales. I had supposed that a few of the extracts which I have adduced from Fétis's own works would have spoken for themselves and have convinced anyone who professes critical knowledge that Fétis was a pretender, and that he was unable to understand the Greek treatises which he had before him. Your reviewer, however, is far too staunch-headed to be convinced, even though Fétis assumes to correct Aristoxenus in Greek, and Josephus in Hebrew.

My own conviction is unchanged by the second, third, and fourth volumes of Fétis's History. I find the same system of charging error upon others when he alone is in fault, and the same inability to understand the books before him. For instance, he had Kosegarten's translation of El Farabi's treatise on Persian, Greek, and Arab music, written at the beginning of the tenth century, but he could not discover from it that the Persians had then no thirds of tones in their scales. Neither did he find out that the Arabs had then emancipated themselves from the Greek minor scales, and had an excellent two-octave major scale, with perfect thirds in it, and a major seventh. It differed from ours, but rather for the better. These two points are most important in history, for in them we trace the comparative civilisation from which those nations have declined.

As to Helmholtz's new musical theories, your reviewer complains that I have described his book as "hasty," when "it is the result of eight years' labour." I think ill-considered conclusions may, in polite terms, be described as "hasty." Secondly, that I have said, "Some very necessary experiments, such as those upon harmonics, were omitted." I am quite of that opinion, for I differ with him as to the existence of "*over*-tones," and I adduce proof that harmonics are *subsequent* to the principal notes, and not simultaneous.

My arguments are before the world, and I have found them supported by others, including two of the very highest authorities. Until they can be rebutted, I have nothing to withdraw, but have much to add to them.

The "Tonempfindungen" is not a book which requires more than ordinary intellect to understand; therefore such deep submission as that of your critic is not necessary. When Helmholtz informs his readers that thirty-three *consonant* vibrations between B and C cause the *dissonance* of that interval, he is literally telling them that white is black; and yet this critic would have us believe him. WM. CHAPPELL

Strafford Lodge, Oatlands Park, Surrey

Origin of Bright Colouring in Animals

THOSE who are moderately well acquainted with Mr. Darwin's writings are not likely to feel that Mr. Murphy's criticisms (vol. xi. p. 148) upon them require any answer; but as many of your readers are probably not so well acquainted with these writings as they ought to be, I shall briefly expound the points raised.

1. Mr. Murphy himself admits that coloration may be as "variable within the limits of the same species" as is "any other part of the organism." In view of this fact, then, why is there any more difficulty in the way of our accepting sexual selection as a *vera causa*, than there is in the way of our accepting natural selection as such? Moreover, we must remember that animals have probably a much keener sense than we have of differences in form and colour among individuals of their own species.

2. Ornamental colouring is, as a rule, confined to the male, because, in Mr. Darwin's words, "the males of almost all animals have stronger passions than the females." I wonder that anyone can have read the "Descent of Man," and afterwards have asked the question to which this is the answer. Compare especially pp. 221, 222 (2nd edition).

3. I do not know on what "evidence" Mr. Murphy relies to "prove that the female is passive," in the sense of not exerting "any choice or power of selection whatever;" but I am quite sure that it must be something very great, if it is to neutralise the vast body of facts which Darwin adduces on the other side; for surely no one can doubt that "the elaborate manner in which the male birds and other animals display their charms before the female," is one of the strongest arguments we could desire to have "in favour of the belief that the females admire, or are excited by, the ornaments and colours displayed before

them." (*Ibid.* p. 541.) Mr. Murphy's assertion that his view of the case is "certainly supported by the very general fact of the males fighting for the possession of the females," makes against his argument if we consider another "very general fact," viz., that there is a sort of inverse proportion between pugnacity and coloration. For an answer to the next paragraph, compare "Descent of Man," pp. 225 and 226.

I do not know that I can quite agree even with your correspondent's closing paragraph. If we can imagine such a state of things as a colony of women left entirely to themselves, I think it is at least open to question whether their "love of dress and ornament" would not begin to decline.

A Disciple of Darwin

"Ring Blackbird"

The bird about which your correspondent C. M. Ingleby inquires is figured in most works on Ornithology as the Ring Ousel—is a local, not uncommon, but generally exceedingly shy bird. Through the late severe weather, however, and for a few days after the thaw, a cock bird has been a daily and very interesting visitor on my lawn. They are generally found on commons and in the neighbourhood of retired copses, and are only driven by stress of weather so near houses.

Bregner, Bournemouth, Jan. 9 Hervey Cecil

[Another correspondent, F. B. Doveton, writes to the same effect, but states his belief that the Ring Ousel is only a summer visitant with us, its winter habitat being Southern Europe and Africa.—Ed.]

THE NEW WESTERN CHINA EXPEDITION

We are glad to learn that the Western China Expedition which left Rangoon in the middle of last month to reopen the old trade-route between Upper Burmah and Yunan, as we intimated a fortnight ago, has an efficient scientific staff attached to it. Col. Horace Browne is the commander of the expedition, and Mr. Ney Elias, Gold Medallist of the Royal Geographical Society and Assistant Political Resident at the Court of Mandalay, is the topographer. Dr. John Anderson, Director of the Imperial Museum at Calcutta, who was recalled from leave in England for the purpose, has been appointed medical officer and naturalist, and takes with him four collectors—two zoological and two botanical.

The expedition was provided at Calcutta with an efficient guard of fifteen Sikh soldiers, picked men from the fort, and two native doctors. At Rangoon they were to be joined by an Attaché of the British Embassy at Pekin, and a Chinese interpreter. Another of the Pekin Attachés, with an interpreter and guard, is to be despatched from Shanghai into the interior of China to meet them. These Attachés will be of the greatest use in keeping the expedition right as regards their intercourse with the Chinese officials. Dr. Anderson takes with him a fine photographic apparatus, which he will use himself. A considerable sum has been laid out in presents for the chiefs and other personages expected to be met with during the route: for the Viceroy of Yunan, two fine horses and a pair of kangaroo-hounds have been selected, and a large number of other appropriate objects.

The expedition is expected to be able to make its way from the upper waters of the Irawaddy to those of the Yangtse-Kiang in the course of a few months, and will descend the latter river to the sea-coast of China. The Chinese Government has given every facility in the way of passports, so that there is every prospect of a successful result.

THE ACCLIMATISATION OF SALMON IN OTAGO

A RENEWED attempt is now being made to acclimatise the British salmon (*Salmo salar*) in New Zealand. The preliminary stages of the necessary operations have been carried out in Scotland, under the personal direction of Mr. Buckland, one of her Majesty's inspectors of salmon fisheries, and the ship, the *Timaru*, containing the precious freight, has sailed from the River Clyde, and is now, it is to be hoped, a far way on her voyage.

What has been done is as follows:—A quarter of a million of eggs have been taken from large, living salmon captured expressly for the purpose. These ova have been treated on what may be called the "piscicultural plan," that is, the eggs have been forcibly extruded from the fish in a vessel filled with water, by means of gentle pressure applied to the abdomen, from which they fall quite easily; after the ova are washed they are carefully impregnated with the milt of the male fish, and are then ready to be laid down on the hatching boxes. On the present occasion the eggs were brought from Perthshire, where they were obtained, chiefly from tributaries of the rivers Forth and Tay, to Glasgow, in order to undergo the process of packing for their long voyage. It is gratifying to know that only a very small portion of the eggs were spoiled while undergoing the process of being fecundated.

The plan adopted on the present occasion was to pack the ova on trays of perforated zinc, on which had been placed a thin layer of well-washed moss. The trays containing the precious ova were then arranged in a series of boxes, each of them a foot cube; these boxes will be carried to their destination in a cabin expressly built for them, paved with ice to the depth of about two feet, and having walls of ice three feet in thickness. A stratum of the same material is inserted between each box, so that the eggs during the passage of the *Timaru*, which may take a hundred days, will be kept at a very low temperature. Great pains have been taken in the packing of the eggs, and also as regards the disposition of the boxes in the ice-house, which will be hermetically sealed, and not be broken open till the ship is in port. It is an important circumstance in favour of this experiment that the eggs selected were all taken from fish which, judging by their dimensions, would be of considerable weight; not a few of them must have weighed over twenty-five pounds. They were not in the least injured during the process of compulsory deprivation of their eggs and milt, but when restored to the water went off quite lively, and as if they had enjoyed the process of artificial spawning.

The ship is expected to reach her destination, Bluff Harbour, New Zealand, about the end of March, at which date all the salmon eggs which she carries would, in the natural state, have become living fish, and, indeed, be a week or two old. The *Timaru*, as the time approaches for her arrival in New Zealand, will be anxiously watched for, and it is to be hoped that all the future stages of this important experiment will be as carefully gone about and as successfully accomplished as the initiatory operations.

The development of the ova whilst the ship is on her voyage will be largely prevented by the very low temperature which must result from the enormous quantity of ice that is in use. How far the rivers of New Zealand, seeing that upon the arrival of the eggs they will be at an autumnal temperature, may be suited for the ripening of the fish, has yet to be determined. We sincerely hope all the conditions will be favourable to the hatching and growth of the salmon. It will prove a singularly interesting task to trace the history of *Salmo salar*, so to say, from its creation, and to watch its progress from one stage of its life to another. We anticipate in the process the correction of many errors which have crept into the details of its natural history, so far as we know it at present.

The physical conditions of New Zealand have been depicted as being very similar to those of the old country; the resemblance will appear still more striking to emigrants when they see the finest fish of the old country leaping in its rivers.

ON THE EXISTENCE OF THE FALLOW DEER IN ENGLAND DURING PLEISTOCENE TIMES

MR. SCLATER'S translation of Dr. Jeitteles' essay on the geographical distribution of the Fallow Deer in present and in past time (NATURE, vol. xi. p. 71), and the careful criticism which it has called forth on the part of Mr. Boyd Dawkins (*loc. cit.* p. 112), have renewed in my mind a conviction which I formed some years ago, namely, that *Cervus brownii* and *Cervus aama* are identical, and that under the former title the fact of the existence of the Fallow Deer in England during the Pleistocene period lies in some degree obscured.

The interest which, doubtless, Dr. Jeitteles' essay has excited induces me to believe the present to be a fitting occasion to endeavour to demonstrate the probability of this conviction. In his original description of *Cervus brownii* (Quart. Geol. Journ. 1868, p. 514), Mr. Boyd Dawkins thus writes:—

"The antlers of *Cervus brownii* are totally unlike those of any existing species excepting *Cervus dama*, to which they approach so closely that the type-specimen was considered by Dr. Falconer to belong to the latter. The basal half, indeed, so strongly resembles the corresponding portion of that of *Cervus dama* that it would be almost impossible to differentiate fragments from which the coronal portion had been broken away. But the resemblance ends at the second tyne (*c*). If the series of antlers of *Cervus brownii* be compared with those of the Fallow Deer which have been reproduced from Prof. Blasius's valuable work, there is this important difference visible: in the former the third tyne (*d*) is present on the anterior aspect, while in the latter it is altogether absent. With this exception the antlers of the two species are most closely allied; and Pl. xvii. Fig. 4 corresponds almost exactly with Pl. xviii. Fig 5, the third of the series of antlers selected by Prof. Blasius as typical of *Cervus dama*. To the objection that the development of the third anterior tyne may have been an accident, it may be answered that it is to be found in none of the endless variations of form assumed by the antlers of the Fallow Deer, and that it is presented also by a far more ancient cervine species from the crag of Norwich."

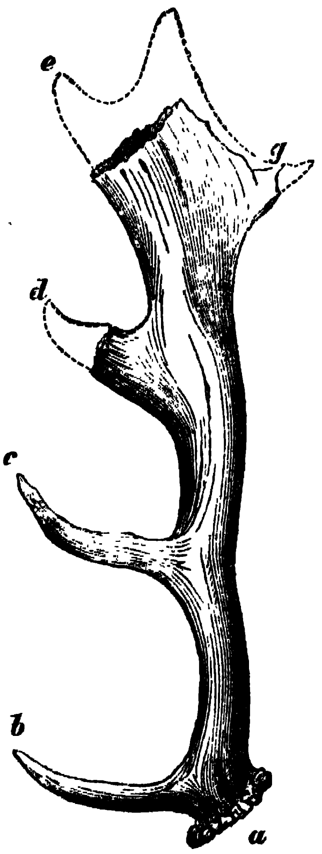

FIG. 1.—Type of *Cervus brownii*.

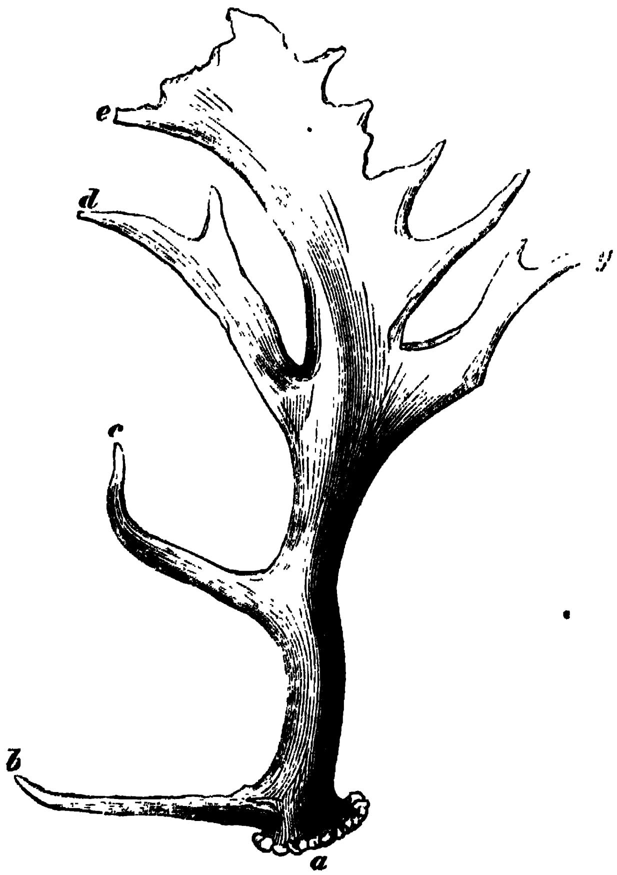

FIG. 2.—Right Horn of Wild Greek Fallow Deer.

It is therefore clear that in its possession of the third tyne (*d*) is centred, according to Mr. Boyd Dawkins, the Clacton Deer's sole right to be considered specifically distinct from the common Fallow Deer. The accompanying drawings (Figs. 1—4) will, I think, be found to show the insufficiency of this character. Fig. 2 represents a horn of the wild Fallow Deer from Greece; Fig. 3 that of a wild Fallow Deer from Sardinia. In both of these specimens the third tyne (*d*) will be seen to be largely developed. These horns are selected from a considerable series brought to me by my brother, Mr. Basil Brooke, direct from Greece and Sardinia, and in none of the other specimens is this tyne developed, but in all the anterior aspect of the horn resembles ordinary specimens of the horns of *Cervus dama*, such as those reproduced by Mr. Boyd Dawkins from Prof. Blasius's work. Fig. 4 illustrates still further the instability of the foundation upon which is based the specific separation of *Cervus brownii*. The horn here figured belonged to a deer which lived and died in one of my own parks. The third tyne (*d*), so distinctly shown in the figure, was produced but once in the course of the animal's lifetime, neither its companion horn nor those which preceded or succeeded it showing the smallest trace of it.

It may be remarked that the tyne *d* in the type of *Cervus brownii* (Fig. 1) stands at a lower level in relation to the greatest palmation of the horns, than is the case in the other three specimens. The explanation of this discrepancy is very simple. The former represents (as its own characters and a comparison of it with the remainder of the fragments with the species found at Clacton readily prove) a young animal, probably a buck of four years of age, whilst the other figures represent the horns of adult animals. In the immature Clacton Deer the force expended in producing the abnormal tyne *d* well-nigh exhausted the supply at the command of a system fully occupied with the production of things more needful, namely, materials for the vigorous increase and consolidation of flesh and bone. Hence the long, attenuated palm, which probably ended very much in the manner in which Mr. Boyd Dawkins has restored it. Analogous instances of excess of growth in one direction, causing a corresponding defect in another, may be seen in all large collections of deers' horns; indeed, in my own collection I find the horn of a young fallow buck, in which the characters specially alluded to in the type of *Cervus brownii* are shown in a still more marked degree.

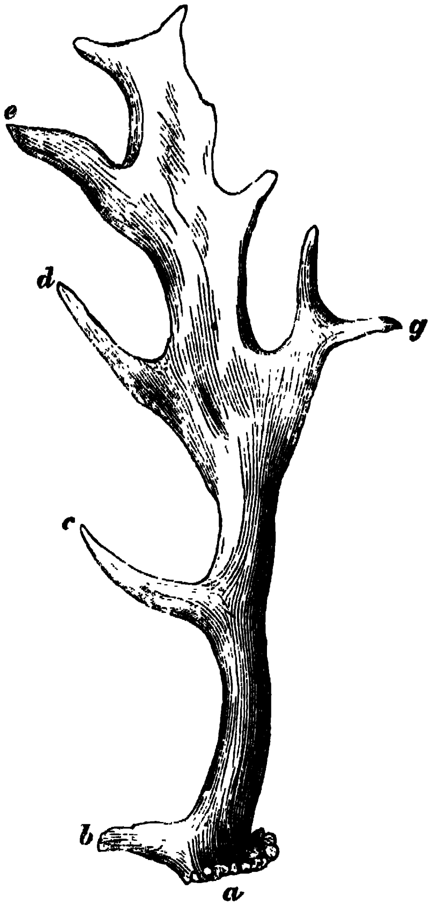

FIG. 3.—Right Horn of Wild Sardinian Fallow Deer.

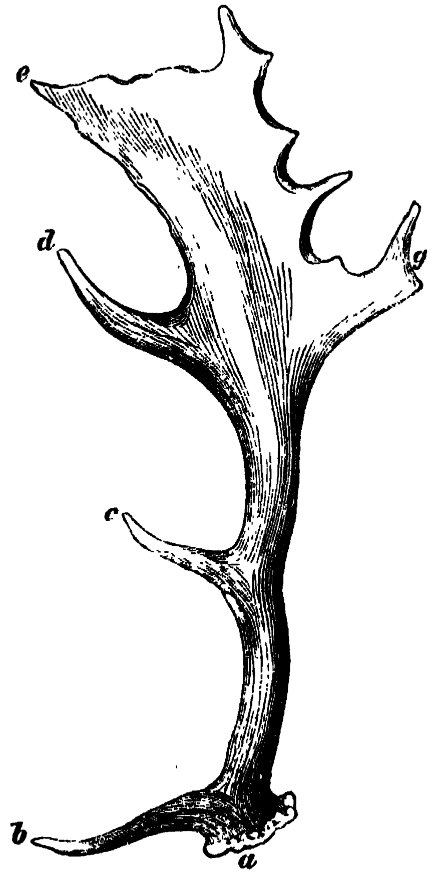

FIG. 4.—Right Horn of Park Fallow Deer.

These facts appear to me fully to justify the rejection of *Cervus brownii* as a species distinct from *Cervus dama*, and therefore to warrant the belief in the existence of this species in England during Pleistocene times. Whether the Fallow Deer became extinct in Northern Europe before the advent of Prehistoric man, or whether it continued to exist in these islands even at the commencement of the Roman occupation, are questions which strike me as altogether beside that of the truth of the "ancient belief" to which Mr. Boyd Dawkins shows such firm allegiance. In either case, the species may have been reintroduced by the Romans, a people whose magnificently lavish expenditure upon luxury and pleasure despised bounds.

VICTOR BROOKE

HELMHOLTZ ON THE USE AND ABUSE OF THE DEDUCTIVE METHOD IN PHYSICAL SCIENCE[*]

WE have still to speak of his attack on the authors of this book with regard to the emission theory of light. They say that such a theory is not to be justified unless a light-corpuscle has been actually seen and investigated. In this demand Mr. Zöllner detects "an impossibility which is not simply physical, but even logical, and which it is easy to expose. In fact, if the sensation of light is produced only when the corpuscles come in contact with our nerves, it is obviously *impossible* to have any ocular perception of such a corpuscle *before* it has touched or affected our nerves of sight." And then this remark is followed by declamation about gross blunders in logic, absolute nonsense, and so on. And, in fact, there is absolute nonsense here; only the nonsense does not lie in what the English writers have said, but in the interpretation which their opponent has put upon their words. Does a man who believes himself so superior to his antagonists in the firmness of his grasp of the principles of the theory of knowledge, still need to have it explained to him that to *see an object* means, according to the emission theory, to receive in the eye, and so to feel, the corpuscles of light that rebound from the object in question? But, this being so, there is no logical impossibility, and nothing inconsistent with the premises of the theory, in the supposition that a light-corpuscle at rest—and the corpuscles are at rest as soon as they are absorbed by dark bodies—may throw off other corpuscles that impinge on it, and so may become for these a centre of radiation, which will be visible as the radiant point. Whether such a process can be brought under observation, and how this is to be effected, are, of course, questions which, on the argument of the English authors, fall to be answered by those who undertake the direct proof of the existence of the corpuscles. And whatever opinion one may form of the stringency and fitness of this demand, it involves no logical contradiction, which is the very point on which the argument must turn if Mr. Zöllner is to make good his case.

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[*] Concluded from p. 151.

I will mention one other objection of similar scientific value, because it refers to Sir W. Thomson, though not to a passage of this book. The point in question is whether it is possible for organic germs to be present in meteoric stones, and so to be conveyed to worlds which have become cool. In his introductory address to the British Association at Edinburgh, in the autumn of 1871, Sir W. Thomson characterised this view as "not unscientific." Here, too, if an error has been committed, I must profess myself a sharer in it. I had, in fact, indicated the same view as a possible explanation of the transmission of organisms through interstellar spaces at a somewhat earlier date than Sir W. Thomson—in a lecture which was delivered at Heidelberg and at Cologne in the spring of the same year, but is still unpublished. If anyone chooses to regard this hypothesis as highly or even as extremely improbable, I have nothing to object. But if failure attends all our efforts to obtain a generation of organisms from lifeless matter, it seems to me a thoroughly correct scientific procedure to inquire whether there has ever been an origination of life, or whether it is not as old as matter, and whether its germs, borne from one world to another, have not been developed wherever they have found a favourable soil. The physical reasons alleged by Mr. Zöllner against the view in question are of very little weight. He points to the heating of the meteoric stones, and adds (p. 26): "Thus, even if we suppose that when the parent body was shattered, the meteoric stone covered with organisms escaped with a whole skin, and did not share the general rise of temperature, it was still necessary for it to pass through the terrestrial atmosphere before it could discharge its organisms to people the earth."

Now, in the first place, we know from oft-repeated observations that of the larger meteoric stones only the very surface is heated in passing through the atmosphere, the inner portions remaining cold, or even very cold. All germs, therefore, that happened to be in cracks of the stone would be protected from combustion in our atmosphere. But even germs lying on the surface would doubtless, when they entered the very highest and most attenuated strata of the earth's atmosphere, be blown away by the powerful current of the air long before the stone reached the denser parts of the gaseous mass, where the compression becomes great enough to generate considerable warmth. And on the other hand, with regard to the collision of two worlds as assumed by Thomson, the first consequences of such an event would be violent mechanical motions, while heat would be generated only in proportion as these motions were destroyed by friction. We do not know if this would last for hours, or days, or weeks. The fragments, therefore, projected in the first instant with planetary velocity might escape without any development of heat. I do not even think it impossible that a stone, or swarm of stones, flying through lofty strata of the atmosphere of a world might catch up and sweep along a quantity of air containing unburnt germs.

I have already said that I should not yet be willing to put forth all these possibilities as probabilities. They are only questions the existence and range of which must be kept in view, so that if opportunity offers they may be solved by actual observation or by inferences from such.

Mr. Zöllner then ascends to the two following propositions :—

"That scientific investigators in the present day attach such extraordinary importance to *inductive proof* of *generatio æquivoca*, is the clearest mark of their lack of familiarity with the first principles of the theory of knowing."

And again :—

"In like manner the hypothesis of *generatio æquivoca* expresses . . . nothing else than the condition for the conceivableness of nature in accordance with the law of causality."

Here we have the genuine metaphysician. In view of a presumed necessity of thought, he looks down with an air of superiority on those who labour to investigate the facts. Has it already been forgotten how much mischief this procedure wrought in earlier stages of the development of the sciences? And what is the logical basis of this lofty standpoint? The correct alternative is clearly this :—

"Either organic life began to exist at some particular time, or it has existed from all eternity."

Mr. Zöllner simply omits the second of these alternatives, or thinks that he has set it aside by a passing reference brought in shortly before to certain physical considerations which are not in the least decisive. Accordingly his conclusion, which affirms the first of the alternatives above stated, is either not proved at all, or proved only by the aid of a minor resting on physical arguments (and, for that matter, inadequate physical arguments). The conclusion, therefore, is not in any sense, as Mr. Zöllner believes, a proposition of logical necessity, but at most an uncertain inference from physical considerations.

This is what Mr. Zöllner has to object to the authors of this handbook in the sphere of scientific questions.[*] Mr. Zöllner's book contains a great number of other accusations of precisely the same value directed against other scientific investigators, with the same confidence in his own infallibility and the same rash haste in passing judgment on the intellectual and moral qualities of his antagonist. Another opportunity will present itself for the discussion of another part of these cases. If I may draw by anticipation a moral interesting to us in the present connection, I would say that no theoretical arguments can present to the attentive and judicious reader a stronger and more eloquent justification of the strict discipline of the inductive method, the loyal adhesion to facts which has made science great, than is supplied by the practical example of the consequences of the opposite, would-be deductive, or speculative method given in Zöllner's book; and this all the more that Mr. Zöllner is beyond question a man of talent and knowledge, who did most promising work before he fell into metaphysics, and even now shows acuteness and the faculty of invention whenever he is limited to the field of the actual, *e.g.* in the construction of optical instruments and the devising of optical methods.

NEW ZEALAND PLANTS SUITABLE FOR PAPER-MAKING

THE utilisation of waste materials for paper-making is a subject upon which a great deal has been said and still remains to be said and done. In every country waste vegetable matter which contains fibre in anything like suitable proportions is sure to attract much attention. The subject has been handled in various works, directly or indirectly, in this country as well as on the Continent; and with regard to Australian plants suitable for paper-making, Baron Mueller, of Melbourne, issued a lengthy treatise in connection with a series of specimens of paper actually made from the plants enumerated and exhibited in the Paris Exhibition of 1867. We have now before us a paper by Mr. T. Kirk, F.L.S., of Wellington, on some indigenous materials of New Zealand suitable for the manufacture of paper. The plants enumerated occur in great abundance in different parts of the colony, and, it is said, are being yearly destroyed to an enormous extent by the progress of settlement. Most of the plants alluded to in this paper belong to the endogenous group, Liliaceæ and Cyperaceæ being the chief natural orders. In the genus Astelia a group of small tufted sedge-like plants belonging to the first-named order, five species of which are described as occurring in New Zealand, four are recommended, both on account of the quantity of fibre contained in their leaves, as well as for the abundance with which the plants grow. *A. Solandri*, the Tree-flax of the colonists, is a plant with numerous radical leaves, from one to two feet long, thickly clothed at the base with shaggy silky hairs, and containing a quantity of good fibre. It is abundant on lofty trees and rocks throughout the colony, resembling in the distance the nest of some large bird. "Hundreds of tons" of this plant, it is said, "are destroyed on every acre of forest-land cleared in the North Island."

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[*] In the region of personal questions, and with reference to the claim of priority as to the principles of spectral analysis made by Sir W. Thomson for Mr. Stokes against Mr. Kirchhoff, I must side with the latter, fully agreeing with the reasons which he has himself brought forward.

A. Banksii and *A. Cunninghamii*, both of which have a similar habit to the first-named species, but with narrower and much longer leaves, sometimes from three to six feet in length, produce a superior fibre. The first is found in great abundance in wooded places near the sea, and the latter is common on trees and rocks. Both are abundant in the North Island, "but their southern distribution is uncertain."

A species of Astelia, known as the Kauri Grass, and called by Mr. Kirk *A. trinervia*, is said to be "the most abundant of all the species, occasionally forming the chief part of the undergrowth in the northern forests up to 3,000 ft., and so dense that it is often difficult to force one's way amongst the interlaced leaves, which are from three to eight feet long, and of a paler green tinge than either of the preceding. It could be procured by hundreds of tons, and as, like other species, it is found in situations not adapted for ordinary cultivated crops, a permanent supply might be fairly calculated upon. Experience has shown that it may be cut yearly."

In the allied genus Cordyline, which is composed of shrubby or small palm-like trees, the Ti, or cabbage-tree (*C. australis*), is the most important. It attains the greatest height of any of the New Zealand species, averaging from ten to twenty or even thirty feet, and producing a trunk usually from ten to eighteen inches in diameter, but sometimes even three feet across. The plant is very abundant in many districts, and the leaves contain a very large quantity of fibre. *C. Banksii*, a smaller growing species, with a trunk from five to ten feet high, produces a fibre of superior quality, but less abundant; the plant, however, is very plentiful on the margins of forests, gullies, &c., all over the North Island, and in the northern parts of the South Island.

That the leaves of the Cordylines are suitable for paper-making there can be no doubt. In appearance, when dry, they very much resemble the so-called palmetto leaves which have recently been brought into this country from America for the purpose of competing with esparto. These palmetto leaves are those of one or more species of Chamærops, perhaps *C. serrulata*, which is known in some parts of the Southern States as the Saw Palmetto. The leaves of *Cordyline australis* are not altogether unknown in Europe as a paper material, for it appears that some years since a quantity was sent to England from New Zealand specially for trial, and were made into paper at a mill in Yorkshire: at that time the leaves were highly recommended for the manufacture of a superior kind of paper. A leaf somewhat similar, but generally of softer texture, is that of the genus Freycinetia. *F. Banksii*, known as the New Zealand Screw Pine, is abundant in most woods, and it is said that the leaves might be procured by thousands of tons. *Gahnia setifolia*, which is abundant in both islands and capable of being procured in almost unlimited quantity, is recommended for the manufacture of coarse paper. The Gahnias are a group of tall-growing, coarse, rigid cyperaceous plants, with long, harsh, cutting leaves, from which fact the plants are known in some parts of the colony as "cutting grasses." The genus is distributed through New Zealand, Australia, Tasmania, the Malayan and Pacific Islands.

The large order Compositæ, containing as it does such a variety of plants, from trees down to shrubs and herbs, might be expected to include many whose woolly foliage would prove useful for paper-making. The genus Celmisia, however, is the only one mentioned in the paper under consideration; the species are perennial bulbs, with radical, rosulate, simple leaves, mostly covered with a white or buff-coloured tomentum, which gives them a leathery texture, and hence the plants are called Leather-plants, or Cotton-grass. The commonest species in the islands is *C. longifolia*, which ascends to an elevation of 5,500 feet, and varies much in height, length, and breadth of leaves, as well as in general robustness. *C. verbascifolia* is a fine species, with broad coriaceous leaves averaging from four to eight inches long, but, according to Mr. Kirk, growing sometimes to a length of two feet. *C. coriacea* is likewise an abundant species, with thick leaves from ten to eighteen inches long, and from half an inch to two-and-a-half inches broad, covered on their upper surface with matted silvery hairs, and on the other with thick silvery tomentum. These leaves are said to make a good paper material; it is certain that when dry they are very tough, and the natives make them into strong and durable cloaks.

The plants here enumerated are only a few of those considered likely to prove valuable in the colony for paper material; they are selected because of their being little or perhaps not at all known for economic uses. Such well-known plants as the New Zealand Flax (*Phormium tenax*) are passed by with a simple mention of the fact that a company has recently been formed in Auckland, specially for utilising its fibre in the manufacture of paper.

While on the subject it may not be quite out of place to mention, in reference to the notice on the use of *Zizania aquatica*, in NATURE, vol. xi. p. 33, that several of the North American daily papers, as the *New York Tribune*, *Montreal Gazette*, &c., are printed on paper made entirely from this plant, and that the promoters of its use in England propose to bring it to this country in the form of half-stuff, to save expense of freight.

JOHN R. JACKSON

A FRENCH OFFICIAL ACCOUNT OF THE ORIGIN OF THE ROYAL SOCIETY

WE find in the first volume of the "Memoirs of the French Academy" a few curious details relating to this subject which may be of some interest to our readers. We translate the text *verbatim*, with the addition of a few explanatory remarks. These details were originally published in Latin, by the first perpetual secretary of the Academy, and may therefore be considered as official.

"Full fifty years had elapsed (in 1666) since the learned men who lived in Paris began to meet at the abode of Father Mersenne, who was the friend of the most learned men in Europe, and was pleased to be the centre of their mutual visits.* MM. Gassendi, Descartes, Hobbes, Roberval, Pascal (father and son), Blondel, and some others met at this place (close to the Place Royale, in a convent). The assemblies were more regularly held at M. de Montmort's, Master of Request in Parliament (and editor of Gassendi's works[*]), and afterwards at M. Thevenot's.[†] A few foreign visitors to Paris were present at these meetings. . . . It is possible that these Paris assemblies have given birth to several Academies in the rest of Europe. However, it is certain that the English gentlemen who created the Royal Society had travelled in France, and had visited at Montmort's and Thevenot's.

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* Father Mersenne was the intimate friend of Descartes, and his philosophical propagandist. It was not deemed prudent by the writer to mention Descartes' name, except as coupled with others.

"When they were again in England they held meetings at Oxford, and kept on practising the exercises to which they had been accustomed in France. The rule of Cromwell was beneficial to these meetings. These English gentlemen, secretly attached to their legitimate lord, and unwilling to take any part in public affairs, were very glad to find an occupation which would give them an opportunity of living far from London without being suspected by the Protector. The Society remained in this state up to the time when Charles II., having resumed the kingly office, brought it to London, confirmed it by his regal power, and gave it privileges. So Charles II. rewarded the sciences which had lent an easy pretext for keeping the faith towards him."

The narrative explains that the creation of the Royal Society was an example given to Louis XIV. for establishing his Academy of Sciences.

THE TRANSIT OF VENUS

SINCE our last notice of the Transit observations, a letter, dated Mauritius, Dec. 10, has been received by the Astronomer Royal from Lord Lindsay, containing a detailed account of the results he obtained. Besides, a brief statement of the observations of Mr. Meldrum, the Director of the Government Observatory, Mauritius, has appeared in the *Times*, with news from other observers, which, with its comments upon them, we reproduce in a condensed form.

Mr. Meldrum, with a perfect telescope of six inches aperture, by Cooke, of York, has been fortunate enough to obtain an observation of the ingress, although both Lord Lindsay and the German party were prevented from doing this by the cloudy state of the sky. But, although Mr. Meldrum obtained the two interior contacts, clouds and haze were at intervals passing over the sun, which, in fact, was obscured during the greater part of the transit. At times, beautiful definitions of the planet were noted, especially soon after the first interior contact. Then there was a long period of obscuration, after which, most fortunately, the sun shone out for the second interior contact. Only the first exterior contact was lost, the sun not appearing at all until 6h. 16m. A few minutes before the last exterior contact the sun was again obscured, and when the clouds passed away the transit was over.

Lord Lindsay states that his expedition has been in a great measure successful. The morning of the 9th was cloudy before sunrise, and for a short time afterwards. The first external and first internal contacts were missed from this cause; the sun was not seen until 1h. 2m. after the first external contact, when it came out for a few minutes, when photographs and measures were obtained. It was not till 8 A.M. (local mean time) that it became fairly fine, and remained so with small periods of cloud obscuration until the end of the transit. Lord Lindsay took 271 plates, out of which number, perhaps, 110 will be of value. One of his photographs shows the second internal contact beautifully.

With the heliometer, Mr. Gill obtained five complete determinations of greatest and least distance of the centres of the sun and Venus, besides nine measures of cusps and two separate determinations of the diameter of Venus near the end of the transit. Dr. Copeland obtained, with the six-inch equatorial and Airy double-image micrometer, fifteen measures of least distance of Venus from the sun's limb, and ten measures of cusps. Dr. Copeland also observed the last internal and external contacts with this instrument. The last internal contact was observed with the four-inch equatorial and the polarising eye-piece by Mr. Gill. He also observed the last external contact with the heliometer. Both Dr. Copeland and Mr. Gill agree that the contacts of Venus and the sun are remarkably similar to those seen in the model. They also agree that any phenomena which could be classed under the head "black drop" took place and disappeared within a period of five seconds. All the photographic exposures are automatically registered on the chronograph by a method which gives the actual duration of the exposure. The heliometer observations were also registered there. Dr. Copeland observed by eye and ear; all other observations (photographic and heliometric) also observed by eye and ear as a check on the chronograph. The German expedition under Dr. Low got the third and fourth contacts, with three complete sets of heliometric measures.

With regard to the operations of the party sent out by the Government of Holland to Réunion, the further information shows that there, as at Mauritius, the ingress was missed altogether, in consequence of the bad weather. The second interior contact at egress was observed both by Dr. Oudemans and Dr. Soeters, not the least trace of the black drop being observed. Only nineteen plates could be exposed, and of these only two or three are considered of value. The observations with the heliometer were more successful. The party, instead of measuring the distance of the planet from the sun's edge along a radius, had calculated beforehand, for each ten minutes, the direction of the most favourable chord for determining the relative parallax of Venus; two sets of eight measures of this kind were recorded.

Some observations made at Colombo by Mr. George Wall, and communicated to the *Ceylon Times*, are of great interest, as here is again recorded an exact reproduction of the appearance observed by Chappe d'Auteroche in 1769. On this the *Times* remarks that it is clear that science will lose much from an incomplete discussion of all the observations made in 1761 and 1769. On this subject we also draw attention to the following letter which we have received from Mr. E. W. Pringle, dated Manantoddi, Wynaad, Dec. 13:—

> "I make no apology for sending you a short account of the late transit as seen by me in Wynaad, especially as I feel some surprise at the difference between the expected and actual phenomena.
>
> "Owing to non-receipt of instruments from England, I had to fall back on a small $2\frac{1}{4}''$ refractor by Cooke, of York, the definition of which is superb, even with a power of 53—that used on the occasion.
>
> "My station was on a hill nine miles from Manantoddi, about 800′ above that place and 3,600′ above sea-level.
>
> "The morning of the 9th was simply perfect; not a breath of air, and not a cloud, with the exception of a wisp or two of cirrus that the sun soon shook off.
>
> "The plateau beneath was wrapped in the fleecy mantle that proved so disastrous to the eclipse observers of 1871, but this I could afford to despise from my more lofty station.
>
> "I missed first external contact, and watched anxiously for the internal contact. When the planet was about half immersed, the entire disc became visible, for the portion external to the solar surface was surrounded by a fine silvery ring like a minute corona. This observation was verified by my brother, and the phenomenon was again visible at emersion.
>
> "As first internal contact approached I looked carefully for the 'black drop,' but, to my astonishment, the horns of the sun grew nearer and nearer, and at last seemed to fade into the last portion of the before-mentioned silvery ring, without my seeing the smallest vestige of the far-famed 'drop,' or any apparent

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[*] Montmort for years entertained Gassendi in his house. He was a very talented *bibliophile*, and all the books from his library now realise an immense value. He was a member of the Académie Française.

[†] Thevenot had travelled much, and was in constant correspondence with many travellers He had been appointed librarian to the King, and lived in the house where the library was kept, in what is now the Rue Vivienne, within a little distance of its present site.

elongation of the limb of the planet. Had it existed to the extent of one hundredth of the diameter of Venus, I am confident I should have seen it.

"At last external contact I fancied that the limb of the sun at point of contact was broken more rapidly than it should be, but if there was a 'bead' it was a very minute one.

"At first internal contact, in spite of the low altitude of the sun, the definition of the perimeters of both it and the planet was excellent; but at last internal contact, owing to the great heat and a strong land breeze, there was some amount of atmospheric interference.

"The time of the transit was taken with an ordinary watch, a good goer, and I hope to be able to fix the position of the station before long, although such observations here must of course be of very secondary consideration.

"During the transit I tried to obtain absorption bands from the atmosphere of the planet, but failed, owing to insufficient power and the difficulty of keeping the slit of the stellar spectroscope used, on the planet, with altazimuth motion.

"I may mention that on the evening of the 9th there was a fair display of parhelia, just at sunset. The sky was then covered with delicate bands of cirrocumulus."

ON THE AGE OF AMERICAN STONE IMPLEMENTS, OR "INDIAN RELICS"

THE interest connected with the various forms of ordinary stone implements, of which arrow-heads are by far the most abundant form, is greatly lessened by the fact that nothing connected with their discovery bears upon the question of the date of their origin. We know about the date of the introduction of iron, by European visitors to our country, and therefore about the time of the abandonment of stone implements and weapons by the Red men; but concerning the time of the commencement of the use of stone here in the States we are almost wholly in the dark.

Having, during the past three years, had unusually favourable opportunities for collecting the various types of relics from a locality extraordinarily rich in them, we have endeavoured to learn something concerning the date of their origin by studying them *en masse* and *in situ*, as in this manner they at least suggest probabilities, which isolated specimens, gathered from numerous and distant localities, would never do. During the past three years we have gathered and carefully examined, as they were taken from the soil, over nine thousand stone implements, embracing fully nineteen twentieths of the forms described by Mr. John Evans in his "Ancient Stone Implements of Great Britain," and some twenty forms of weapons and household implements not mentioned in his work.

The result of the examination of this enormous collection of specimens on the spot where they were found, has been to convince us that the ruder forms, usually of slaty rock and other minerals softer than flint, are older, as a rule, than the beautiful jasper specimens found immediately above them. No such conclusions could be arrived at from merely examining these same specimens in a cabinet, and if these ruder and more elaborate forms were intimately associated in the soil, it would be difficult to dissociate them; but taking the history of the discovery of each specimen separately, we find that just in proportion as these relics are rude in manufacture and primitive in type, *they are more deeply embedded in the soil.* We have *never* met with a jasper (flint) arrow-head in or below an undisturbed stratum of sand or gravel, and we have but seldom met with a rude implement of the general character of European drift implements on the surface of the ground; and when such specimens did occur, there were generally some indications of unusually deep disturbance of the surface of the ground. Indeed, it is in fact just what it should be in theory, *i.e.*, the older forms are found alone, and at considerable depths below the surface; the newer and latest types found only at the surface, except when in graves, and associated with these a few specimens of the more archaic forms; just as we now in our own time see, in some isolated localities, household implements still in use, that, as a rule, have been discarded for better forms for more than a century. We repeat, that the conclusions arrived at by us we claim to be warranted by the fact of their applying to the collection of over nine thousand specimens gathered by us from a limited locality, and examined at the time of their discovery with special reference to the relationship the rude and elaborate forms bore to each other.

The belief here expressed with reference to the relationship of rude and elaborate relics is in accord with the division of the Stone Age into a Paleolithic and a Neolithic era; inasmuch as no indication of a *polish* has been found on any of the rude relics gathered by us; and polished celts and grooved axes with well-ground blades, or edges, occur only on the surface or in graves. It may be well to state here that by the phrase "on the surface" we mean on or in the soil that is now in cultivation. Relics that are upturned by the plough are considered as being "on the surface,"—beneath the surface being the stratum underlying the cultivated soil, and so beyond the reach of the ploughshare.

When and how the Atlantic coast of North America became peopled by the Red men cannot be determined by these same relics; but that that event should have been comparatively recent, and that such rude relics as we now find deeply embedded in the earth, and the magnificently wrought agate and jasper spears, and polished porphyry and hematic celts, should have been in use at the same time and by the same people, is simply incredible. We cannot now go into the full details of all the points of interest connected with our discoveries, but offer with confidence to students of American archæology this fact, that the paleolithic relics are immensely older than the elaborately worked surface-found forms. This fact, we believe, is a powerful support to the theory (if, indeed, it needs further demonstration) of the gradual development of man from the condition we call savagery.

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NOTES

THE invitation addressed by the King of Siam to the Royal and the Astronomical Societies ought to be gratifying to scientific men in more ways than one; it is one more evidence of the spread of a respect for science, and of an idea, however vague, of its high value. The letters amount, indeed, as the *Times* remarks, to the offer of a large subsidy on the part of the King, and are no empty compliment. They indicate in the clearest manner the effect which the steady prosecution of inquiries by the most civilised is having in the less civilised countries; an effect of an important kind, which it would be difficult to arrive at in any other peaceful way. The following is the text of the King's letter to the Astronomical Society:—"The Royal Palace, Bangkok, Oct. 9, 1874.—My dear sir, I have much pleasure in informing you that I have received the commands of his Majesty to request you to inform the Royal Astronomical Society that if it will appoint men of science to observe the total eclipse of April next, his Majesty will be happy to consider them as his private guests during their visit, and will take on himself their entertainment and provide them with transport for themselves and their instruments from Bangkok to the station selected by them and back again, and will erect such temporary buildings as are required for them and their assistants. A communication to this effect will be made by his Excellency the Minister for Foreign Affairs to the Acting British Consul-General here; but as this will be slow in reaching the gentleman interested, his Majesty has commanded me to address this note to you to communicate it to the Society as soon as possible. I shall be most happy to receive any communication from the Secretary of the Society named; and if any gentlemen propose to avail themselves of his Majesty's invitation, I should wish to receive particulars of the probable number of the party or parties, of the station or stations proposed, and the foundations required for instruments—a plan, in fact, for each intended observatory, that I may submit them for his Majesty's orders. You may state that our topographer, Capt. Loftus, and other officers who, as surveyors, are accustomed to precise observations, will be happy to assist if desired, and his Majesty will willingly release them from their other duties for this purpose. With the assurance of my high esteem, believe me, my dear sir, your most faithful friend, BHASHAKARAWONGSE, H.S.M. Private Secretary."

THE great solar eclipse of 1868 was visible in Siam, as the 1875 eclipse will be. The then reigning Siamese king had not invited any European astronomer; but the French Government sent an expedition, who located themselves in Malacca for the purpose of taking spectroscopic observations. The King of Siam, who professed to be an astronomer, came with a royal train and a large army to observe the sun and perhaps the sun-observers. The observations were very successful indeed; but the French astronomers had located themselves on marshy land and were almost all attacked by fever, of which they were cured only on their return to France. Such was not the case, however, with their royal guest, who was also attacked, and died a few months afterwards.

A TELEGRAM, dated Hong Kong, January 9, states that the *Challenger* has left that place in continuation of her cruise.

WE are informed that a subscription list has been opened in Stockholm for the purpose of erecting a monument to Scheele, whose discoveries gave such a powerful impulse to the advancement of chemical science in the eighteenth century.

IT is also reported that there is a probability of a monument being erected in Brussels in honour of the late M. Adolphe Quetelet, the well-known Secretary of the Belgian Academy.

A NEW section of the Glasgow Philosophical Society—Section C, Physics (including Mechanics and Engineering)—has been formed, with Jas. R. Napier, F.R.S., as president, Prof. Sir Wm. Thomson, LL.D., F.R.S., and Prof. R. Grant, LL.D., F.R.S., as vice-presidents, and Thos. Muir, M.A., F.R.S.E., as secretary, and has already begun to do good work in the cause of original research. The success of this section, along with that of the recently organised Science Lectures Association, affords good evidence that in Glasgow, as elsewhere, there is a significant stirring among the dry bones from which we may hope for valuable results in the not distant future.

THE January number of Petermann's *Mittheilungen* contains a letter from Dr. Nachtigal, who has done for the eastern countries of the Sahara and Soudan what Barth did for the central, telling of his return to Cairo after an absence of about six years. He was received by the Viceroy and the German inhabitants of Cairo with the greatest honour. As his health has been considerably impaired by the hardships he has had to undergo, he intended to stay some time in the genial climate of Egypt to recruit, not caring to plunge suddenly into the rigours of a northern climate. Dr. Petermann gives a brief *résumé* of the course of Dr. Nachtigal's journeys.

THE scheme which was proposed about a year ago for the erection of an aquarium, to be built on the beach at Hastings, has been revived, and we are informed that a limited liability company, composed of local capitalists, has been started for the purpose of carrying out the project. The building will be erected a little to the east of the present pier, and one of the two designs to which premiums were awarded last year will probably be adopted.

FROM a previously undisturbed deposit on Funk Island, a guano-covered rock to the east of Newfoundland, several bones of the Great Auk (*Alca impennis*) have been recently brought to this country. They are not in a first-rate state of preservation, being considerably injured by exposure.

THE Marquis of Bute has recently purchased eight Canadian Beavers, seven of which have arrived safely in the Island of Bute, and have been placed in the enclosure constructed for the four which died some time ago on Drumreoch Moor. To increase the chance of their acclimatisation, the animals will be supplied with a certain amount of food for some time to come.

FROM a report of a journey into the interior of Formosa made in the latter part of the year 1873, we learn that the flat portion of the country is almost everywhere cultivated with the greatest care: the principal crops are rice, sugar-cane, and sweet potatoes; and the minor crops, pea-nuts (*Arachis hypogæa*), indigo, and Areca palms. The mountain region, though very steep and rugged, was covered with thick tropical forest. Tree-ferns, as well as other ferns, grew luxuriantly; and in places where there was a bit of level ground, Chinese had formed settlements around which they were growing rice, and were clearing patches of the hill-sides for the cultivation of tea. Formosa is the island from whence we obtain our supplies of the camphor of commerce, but in the interior the trees which abound in the forests are said to be left untouched, as the natives do not know how to make camphor.

THE cultivation of cocoa (*Theobroma cacao*) is being largely extended in Guayaquil. New plantations have been found, and new trees planted on the old estates, so that the average yield will be greatly increased. The crop of 1873 was the largest yield known for many years. Another of the chief products of Guayaquil is indiarubber, or caoutchouc, the yield of which has very much decreased of late, owing to the custom of destroying the trees to collect the gum, so that it has become necessary to go further into the forests in search of the trees, which, together with the increased difficulty of transport, has added much to its first cost.

ONE of the large Blue Gum Trees (*Eucalyptus globulus*) in the Temperate house at Kew is now showing bunches of fruit. These fruits are from three-quarters to an inch in diameter, and are peculiar on account of their hard woody nature, being nearly enclosed by the ligneous calyx, and opening at the apex by valves corresponding in number with the cells.

AMONGST economic plants of interest at present flowering at Kew, the Tea-plant and the Star Anise claim notice. A fine bunch of the Black Tea (*Thea chinensis*), var. *Bohea*, cannot fail to attract attention in the Temperate house at this season, where flowers in general are scarce. Though the genus *Thea* is so closely allied to that of *Camellia*, its flowers are comparatively inconspicuous when compared with those of the well-known *C. japonica*. The large yellow anthers, however, redeem it from insignificance. The Star Anise (*Illicium anisatum*), which find a home in the Economic house, is a native of South-west China, growing to a height of about fifteen feet. The common name of Star Anise is derived from the stellate form of the fruit when ripe, and its odour somewhat resembling that of aniseed. Large quantities of these fruits, with the seeds in them, are exported from China to Europe and India. On the Continent they are largely used to flavour spirits, but with us their chief use is for expressing an essential oil, which is frequently sold for real oil of aniseed.

THE differences between the organisation of the French Academy of Sciences and the Royal Society are striking. Any-one wishing to become a French Academician is obliged to visit each of the electors and to ask personally for their suffrages.

The number of French Academicians is strictly limited, and no new member is appointed except to fill a vacancy. There is a special section open to members who may have no sufficient scientific qualifications; they are called *Académiciens libres*, and belong to no special section, but cannot vote in the election of members, and are not paid.

EXPERIMENTS have been tried on some French railways for warming passenger cars by a stove, which is placed outside. It is said a single stove is sufficient for a whole car, and the expense is very small indeed, twenty-six pounds of coal keeping up the fire for about 200 miles. The warmed air circulates inside the car.

ATTENTION has been drawn in France by the news of the burning of the *Cospatrick* to the proper means for extinguishing fire on board ships. M. de Parville advocates in the *Débats* the obligatory use of signal-thermometers in the hold; each elevation of temperature being notified by the ringing of an electric bell. Others advocate the use of extinguishers. These are large bottles full of compressed carbonic acid, which may be of immense use in limited spaces, perhaps more valuable than water.

WE notice to-day the sailing of the *Timaru*, from Glasgow, with a consignment of salmon eggs for Otago, New Zealand. The ship *Tintern Abbey* has also recently sailed for New Zealand, having on board no less than 1,130 living birds, viz., blackbirds (*Turdus merula*), thrushes (*Turdus musicus*), starlings (*Sturnus vulgaris*), redpoles (*Linota rufescens*), of each 100; hedge-sparrows (*Accentor modularis*), 150; linnets (*Linota cannabina*), 140; goldfinches (*Fringilla carduelis*), 160; yellowhammers (*Emberiza citrinella*), 170; and, lastly, partridges (*Perdix cinerea*), 110. When the birds arrive in New Zealand they will be let fly under proper authority. There is, we understand, a heavy penalty enforced against shooting at or injuring these birds in New Zealand, and it is hoped that they will do well at the Antipodes. The New Zealand farmers cannot get on without them, for they keep down the insects that ravage the crops. The Acclimatisation Society of Canterbury, New Zealand, we understand, have begun and are now persevering in this good public work.

THE weather has been extraordinarily warm and genial in Paris, as in London, and in the whole of France, for some days, but almost all the rivers have been swollen to a dangerous height owing to the rapid melting of immense quantities of snow. Disasters have been experienced along the banks of many streams, principally the Rhone. At Lyons the disasters were increased by a stockade or *barrage* erected suddenly across the stream. All the ice collected and produced an immense iceberg at a point called Ile Barbe. It was feared for a while that this stupendous mass of ice would force its way above the stockade and destroy everything below, and great efforts were made unsuccessfully to get rid of it. But the continuance of the genial temperature has gradually destroyed the obstruction. Never was the theory of regelation, as propounded by Tyndall, submitted to the test of a larger experiment.

MESSRS. H. S. KING and Co. have in the press, and nearly ready for publication, the following works relating to science:—"Mankind: a Scientific Study of the Races and Distribution of Man," considered in their bodily variations, languages, occupations, and religions, by Dr. Peschel.—Translations of two new works by Prof. Ernst. Hæckel: viz., "The History of Creation," edited by E. Ray Lankester, M.A. This book will be illustrated by coloured plates and genealogical trees of the various groups of both plants and animals.—"The History of the Evolution of Man," translated by E. A. Van Rhyn and L. Elsberg, M.D., with various notes and other additions sanctioned by Dr. Hæckel. Also the following new volumes of their International Scientific Series:—"Fungi;" their nature, influences, uses, &c., by M. Cook, M.A., LL.D., edited by the Rev. M. J. Berkeley, M.A., F.L.S. "The Chemical Effects of Light and Photography in their application to Art, Science, and Industry," by Dr. Hermann Vogel, of Berlin; and a treatise on "Optics," by Prof. Lommel, of the University of Erlangen. These three books will be profusely illustrated.

MESSRS. SMITH, ELDER, and Co. will publish, in a few days, a work called "The Cremation of the Dead," by Mr. William Eassie, C.E., who is well known for his work in sanitary matters.

THE cultivation of oysters has been attempted by the United States Commission of Fisheries in the Great Salt Lake of Utah, where numbers of these bivalves from California have been placed with the view of testing the possibility of their thriving there. Some beds were choked by mud brought down some small streams, but in other parts the oysters promise to succeed. Shad have also been placed in the lake and have been seen in good health, and a lot of salmon fry from the Sacramento, artificially hatched out, have been placed in the Jordan and other rivers running into the Great Salt Lake. So far, in the fresh waters, they have done well, and at ten months old were from four to six inches long. It remains to be seen whether they will thrive as well in the salt waters of the lake as in the sea itself. The experiment is a most interesting one, and opens up some curious questions in the natural history of the salmon and the other fish under experiment.

THE Council of the Society of Arts have passed a resolution to the effect that it is desirable that the Cantor Lectures programme be from time to time, as far as may be found practicable, arranged to further the scheme of the Society's Technological Examinations, and that steps be taken for getting such lectures published in a special form as guide-books.

THE third number has been sent us of the *Journal* of the Society for the Promotion of Scientific Industry, whose headquarters is at Manchester. The *Journal*, which is of considerable size, contains reports of the meetings of the Society, at which a number of good practical papers have been read. One of the most scientifically important of these is on "The Chemistry of Calico Printing and Dyeing," by Mr. Charles Dreyfus.

WE have received from the author, M. E. Mailly, a very interesting "Essai sur la Vie et les Ouvrages de M. L. A. J. Quetelet," poet, *littérateur*, geometer, physicist, astronomer, and statistician, doubtless one of the most remarkable men Belgium has produced. As we gave some account of M. Quetelet's life and work shortly after his death, we need not further notice M. Mailly's book, which we recommend to all who desire to know further about this notable man. The publisher is Hayez, of Brussels.

WE are glad to see that Mr. J. E. Taylor's lectures in Ipswich on "Plants, their Structure, and their Uses," have been so successful that it has been found necessary to engage a larger hall than that in which the course was begun.

THE *Bulletin* of the Minnesota Academy of Natural Sciences for 1874 contains a report on the birds and a list of the mammals of Minnesota. There are also geological notes from early explorers in the Minnesota Valley, arranged by Mr. N. H. Winchell.

"THE Safe Use of Steam, containing Rules for the Guidance of unprofessional Steam Users," by an Engineer, seems a book likely to be of practical use to many persons. It is published by Lockwood and Co.

MR. L. SCHWENDLER sends us two papers by him: "On Earth Currents," reprinted from the *Proceedings* of the Asiatic Society of Bengal; and "On the General Theory of Duplex Telegraphy," from the *Journal* of the same Society.

"NOTES on a Till or Boulder Clay with Broken Shells, in the lower valley of the River Endrick, near Loch Lomond, and its relation to certain other Glacial Deposits," is the title of a paper by Mr. R. L. Jack, F.G.S., reprinted from the *Transactions* of the Geological Society of Glasgow.

UNDER the title of "Report of the Government Botanist for the year ending June 30, 1874," Baron von Mueller, of Melbourne, has given a *résumé* of the scientific work of the year, carried on by him or under his immediate supervision. In the first place, Baron Mueller refers to the issue during the year of the sixth volume of the "Flora Australiensis," in the production of which he is associated with Mr. Bentham; towards the composition of the seventh volume he mentions that it will include the Grasses, numbering about 250 species, the Rushes, Sedges, Restiaceæ numbering alone about 70 species, the Naiadeæ, Palmaceæ, &c. With regard to the number of species, however, these may be considerably modified before publication. In reference to a botanical appendix which Baron Mueller made to the works of Mr. F. A. Campbell, of Geelong, on the New Hebrides and the Loyalty Islands, which appendix was drawn up from collections made by the author during a visit to these islands, he says: "By such means we have obtained the first connected records of the insular vegetation of those spots of the globe after the lapse of more than a century since their discovery. Such opportunities for research should also be seized on by other travellers, and especially by educated settlers residing on these islands, as thereby will be gained not merely an advancement for phytographic science, but also a closer acquaintance with the natural productions of any of the Pacific insular lands, to the advantage also of Australian industries and commerce." With regard to the Palæontology of Victoria, Baron Mueller describes the vegetation of the Pliocene period as remarkable for its densely umbrageous trees of almost tropical types, which, as very recently ascertained, spread over very extensive areas, where in the present nothing of the past physiognomic grandeur of the vegetation is left. The elucidation of new economic plants and the tests as to their value in the world of commerce has long been one of Baron Mueller's special points. his pen has produced many pamphlets on these and kindred subjects, and from his laboratory have issued many actual results of his researches in this direction. The large collection of chemical products from the various species of Eucalyptus, Melaleuca, Acacia, &c., together with other vegetable products of Victoria, will be remembered by many as forming one of the principal features of the Australian Court of the London International Exhibition of 1873. This collection, which included oils, tars, acetic acids, and alcohol from species of Eucalyptus, Melaleuca, Casuarina, &c., as well as fibres, papers, and starches, were, at the close of the Exhibition, presented to the Kew Museum, where they are now exhibited. In regard to what Baron Mueller terms "field service," he says he was engaged for seven days in December 1873 in investigating the plants in the forest regions of the Upper Yarra and the southern branches of the Goulburn River. Measurements were also taken at this time of the heights of some lofty trees of *Eucalyptus amygdalina*, the highest of which gave 400 ft. To some trees which appeared to be higher access could not be obtained in the short time allowed and the means at command, as the dense jungle would have to be cleared for a base line. A magnificent species of Festuca (*F. dives*), discovered in West Gippsland by Baron Mueller in 1860, "was now," he says, "ascertained to have a wide range through the forests towards the Yarra and Goulburn sources, where among grasses it forms a most stately object, the height of 12 ft. being not unusual, while occasionally this superb grass, in the fern-tree gullies or rivulets, attains, in rich soil, to 17 ft. The result of this journey," Baron Mueller says, "was the discovery of many plants new to Victoria and a few new to science. So far as the country itself is concerned, the Alps are easily accessible for horses from the eastern side, as the slopes are more gradual. The summits can be traversed for many miles with little or no impediment: being at an elevation of from 6,000 to 7,000 ft., they are above the region of trees and shrubs, and are consequently open in all directions."

WE have received the indexes to vol. vii. of "Patents and Patentees," 1872, for the colony of Victoria. The volume contains three separate indexes: "Subject Matter," "Alphabetical Index of Names," "Chronological and Descriptive," and seventeen sheets of illustrations. The work gives in a compact form a good idea of the activity of inventors in the colony.

THE additions to the Zoological Society's Gardens during the past week include a Black-handed Spider Monkey (*Ateles melanochir*) from Central America, presented by Mr. H. Campbell; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. C. Lucas; a Ring-necked Parrakeet (*Palæornis torquata*), from India, presented by Miss Attwood; a Yellow-bellied Parrakeet (*Platycercus flaviventris*) from Tasmania; and a Little Grebe (*Podiceps minor*), British, purchased.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopical Science* for this month contains several articles and notices of interest, the most important of which are: "Observations on the Anatomy of *Tænia mediocanellata*," by Mr. F. H. Welch, in which the author describes the detailed structure of that species, which, as he remarks, is considerably more common than the better known *T. solium*. Two plates accompany the description; very instructive sections through the segments in different directions occupying one of them.—Mr. C. H. Golding Bird describes the method to be employed in imbedding in elder-pith for cutting sections, a method more simple and frequently as advantageous as imbedding in wax, the moistened pith adapting itself to the inequalities and supporting the substance to be cut, in a most convenient manner, without the necessity for a tripod, spirit-lamp, &c., required when wax is used.—Mr. W. Archer has a paper "On Apothecia occurring in some Scytonematous and Sirosiphonaceous Algæ, in addition to those previously known," in which the transfer by Bornet of *Ephebe pubescens* to the lichens suggested observations as to whether other species, *Stigonema* and allied genera, would not require similar relegation on account of the discovery of apothecia and spermogonia in them. The question as to the nature of these Gonidia-forming Algæ types is discussed.—Mr. Ray Lankester makes "Observations on the Development of the Cephalopoda," in which he continues his elaborate investigations on the development of the Mollusca. The points on which most stress is laid in the present paper are the formation of the blastoderm and the nature of the "autoplasts;" the development of the pen-sac, and of the alimentary canal, and especially of the eye, whose radical similarity in the di- and tetra-branchiate Cephalopoda is proved, at the same time that its great difference from the vertebrate organ is rendered equally apparent.—Mr. H. C. Sorby has a paper "On the Chromatological Relations of *Spongilla fluviatilis*," which is shown to contain much the same colouring matter, soluble in carbon-disulphide, as the highest plants, though in different proportions.—The last paper, reprinted from this journal, is Prof. Huxley's "Classification of the Animal Kingdom," read before the Linnean Society in December last. —A review is given of Stricker's "Manual of Histology," as well as an excellent short life, by Dr. Payne, of Dr. Lankester, one of the founders of the journal.

Astronomische Nachrichten, No. 2,016.—In this number is a list of some thirty stars, of types iii. and iv., discovered by D'Arrest. Notes on colour and bands in the spectrum of each are added.—Oppolzer gives the elements of Winnecke's comet (Comet III. 1819), and an ephemeris for every day, from Jan. 1 to March 1, 1875. The eclipse of the sun of October last was observed by H. Bruns and others at Dorpat; four telescopes were used, of 162, 97, 53, and 77 millimetres aperture respectively. It appears that the first contact was observed to take place earlier with the larger instruments than with the smaller; there is a difference of 44 seconds in time in the case of the 162 and 53 millimetre glasses. H. Bruns also contributes some remarks on the finding of the altitude of falling stars.—Dr. J. Holetschek gives elements and an ephemeris for the planet Peitho (118) for the month of Dec.; and Ormond Stone adds a remark on certain equations in the determination of a comet's distance from the earth.—No. 2,017.—Dr. O. Lohse writes to the editor an account of the method of photographing the sun. He apparently uses collodion, containing chloride of silver, or paper, instead of the ordinary sensitive plate. He remarks that the process has the advantage of requiring no chemical preparation for each photograph, and he says the spots are sharply defined.—Prof. Bredichin sends his positions and observations of 22 of the minor planets, the comets of Winnecke, Borrelly, and Coggia; and Fearnley gives a list of 58 stars with their ascertained positions for comparison with Coggia's comet.—Leopold Schulhof gives elements and an ephemeris for the month of Dec. of Planet (139).—Victor Fuss gives the times of contact of four observers of the solar eclipse of October last.

THE *Bulletin de la Société d'Acclimatation de Paris* for September opens with a curious instance, related by M. Duwarnet, of a cross between the red and common grey partridge; the practical use of which, however, is not apparent, though it is a curious example of a cross between two species of birds hitherto regarded as irreconcilable.—M. La Perre de Roo contributes an article on Military Pigeons, which details the uses to which pigeons may be put for military purposes. Russia, Italy, Austria, and Germany have already created establishments for the breeding and training of pigeons with this object.—M. J. Bech pleads the cause of the small birds in France, most of which, as soon as the legal shooting season commences, are killed in large numbers by sportsmen who cannot find better game. He recommends the absolute prohibition of the slaughter of insectivorous birds.—The acclimatisation of sponges is the latest idea of one of the members of the society, who suggests that the celebrated Syrian sponges might be cultivated in the South of France.—The Notes from America include observations on the Mexican Agave, the introduction of mahogany into India, and the tea-productions of that country.

Der Zoologische Garten.—In the November number Dr. von Olfers discusses the food of the Stork (*Ciconia alba*), and its consequent value to the farmer. He finds the principal items of its bill of fare to consist of frogs, moles, grasshoppers, and the larger carabine beetles.—Dr. Dorner reviews the twelve species of Deer now represented in the Hamburg Zoological Gardens; a Stag (*Cervus elaphus*), aged only two years, has already antlers with twelve points.—H. Thienemann remarks on the habits of the Little Bustard (*Otis tetrix*), which has recently established itself as a breeding species in Thuringia, as has also the Fieldfare (*Turdus pilaris*).—Among the remaining articles are notes on *Plotus levaillantii*, by H. Marno; and on *Tropidonotus tessellatus*, by H. Geisenheyner.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, Dec. 16.—Mr. John Evans, F.R.S., president, in the chair.—The following communications were read:—(1) Descriptions of the Graptolites of the Arenig and Llandeilo Rocks of St. David's, by Messrs. John Hopkinson and Charles Lapworth. Commencing with a brief historical account of the discovery of graptolites in the neighbourhood of St. David's, from their first discovery in the Llandeilo series in 1841 by Sir Henry De la Beche and Prof. Ramsay, the authors proceeded to explain their views on the classification of the graptolites (*Graptolithina*, Bronn), which they place under the order *Hydroida*, dividing them into two groups: *Rhabdophora* (Allman), comprising the true siculate or virgulate graptolites, which they consider to have been free organisms; and *Cladophora* (Hopkinson), comprising the dendroid graptolites and their allies, which were almost certainly fixed, and are most nearly allied to the recent *Thecaphora*. The distribution of the genera and species in the Arenig and Llandeilo rocks of St. David's was then treated of, and the different assemblages of species in each of their subdivisions were compared with those of other areas. The Arenig rocks are seen to contain a number of species which ally them more closely to the Quebec group of Canada than to any other series of rocks, all their sub-divisions containing Quebec species, while the Skiddaw slates, which before the discovery of graptolites in the Lower Arenig rocks of Ramsey Island in 1872 were considered to be our oldest graptolite-bearing rocks, can only be correlated with the Middle and Upper Arenigs of St. David's. The graptolites of the Arenig rocks of Shropshire and of more distant localities were also compared with those of St. David's. In the Llandeilo series of this district the *Cladophora* have now for the first time been found, a few species, with several species of *Rhabdophora*, occurring at Abereiddy Bay in the Lower Llandeilo, which alone has been carefully worked, there being much more to be done in the Middle and Upper Llandeilo, from which very few species of graptolites have as yet been obtained. Some of the recently introduced terms, and altered or more definite terminology, employed in the descriptions of the species were then explained; and the paper concluded with descriptions of all the species of graptolites collected in the Arenig and Llandeilo rocks of St. David's within the last few years of which sufficiently perfect specimens have been obtained, doubtful species being referred to in an appendix. Forty-two species were described, belonging to the following genera:—*Didymograptus*, *Tetragraptus*, *Clemagraptus* (gen. nov.), *Dicellograptus*, *Climacograptus*, *Diplograptus*, *Phyllograptus*, *Glossograptus*, and *Trigonograptus* (Rhabdophora); *Ptilograptus*, *Dendograptus*, *Callograptus*, and *Dictyograptus* (Cladophora). (2) On the age and correlations of the plant-bearing series of India, and the former existence of an Indo-oceanic continent, by Mr. H. F. Blanford. In this paper the author showed that the plant-bearing series of India ranges from early Permian to the latest Jurassic times, indicating that, with few and local exceptions, land and freshwater conditions had prevailed uninterruptedly over its area during this long lapse of time, and perhaps even from an earlier period. In the early Permian there is evidence in the shape of boulder-beds and breccias underlying the lowest beds of the Talchir group of a prevalence of cold climate down to low latitudes in India, and, as the observations of geologists in South Africa and Australia would seem to show, in both hemispheres simultaneously. With the decrease of cold the author believed the flora and reptilian fauna of Permian times were diffused to Africa, India, and perhaps Australia; or the flora may have existed somewhat earlier in Australia, and have been diffused thence. The evidence, he thought, showed that during the Permian epoch, India, South Africa, and Australia were connected by an Indo-oceanic continent, and that the first two remained so connected, with at the utmost some short intervals, up to the end of the Miocene period. During the latter part of the time this continent was also connected with Mayalana. The position of the connecting land was said to be indicated by the range of coral reefs and banks that now exists between the Arabian Sea and West Africa. Up to the end of the Nummulitic epoch, except perhaps for short periods, no direct connection existed between India and Western Asia.

Zoological Society, Jan. 5.—Dr. E. Hamilton, vice-president, in the chair.—A letter was read from Dr. George Bennett, of Sydney, giving an account of an Indian beetle (*Chrysochroa ocellata*), which had been captured alive in the Bay of Bengal, 273 miles from the nearest land, by Capt. Payne, of the barque *William Mansoon*.—A letter was read from Mr. Anderson, of Futteyghur, East Indies, giving an account of the eggs and young of the Gavial (*Gavialis gangeticus*).—The Secretary read a letter addressed to him by the Marquis of Normanby, Governor of Queensland, announcing that he had forwarded by the ship *Ramsay*, under the care of Capt. Carter, a fine specimen of the Australian Cassowary (*Casuarius australis*), as a present for the Society's collection.—A communication was read from Mr. A. G. Butler, giving descriptions of thirty-three new species of *Sphingidæ* in the collection of the British Museum.—A communication was read from Mr. Andrew Anderson, of Futteyghur, giving corrections of and additions to a previous paper by him on the Raptorial Birds of North-western India (P.Z.S., 1872, page 619).—A communication was read from Mr. E. L. Layard, H.B.M. Consul for Fiji and Tonga, containing ornithological notes made in the Fijis, together with descriptions of some supposed new species of birds.

Royal Microscopical Society, Jan. 6.—Chas. Brooke, F.R.S., president, in the chair.—Dr. Ord read a paper on the natural history of the common urates, in which he described the results of a number of experiments with urates of soda and ammonia, carried on with a view to ascertain what was the meaning of the different forms in which they appeared in the animal system. The various forms assumed by these salts in colloid media, and under the action of acids or chlorides, were described at some length, and the subject was further illustrated by drawings and preparations exhibited in the room.—A paper by Dr. Pigott, on the invisibility of minute refractory bodies in consequence of excessive aperture, was read by the Secretary.—Some beautiful sections of a foraminifer (*Alveolina*), both transverse and longitudinal, mounted by Möller, were exhibited by the Assistant Secretary.

Royal Geographical Society, Jan. 12.—Sir Rutherford Alcock, vice-president, in the chair.—A letter was read from Lieutenant-Colonel C. C. Long, a staff officer in the Egyptian service, giving the Society an account of his recent journey to King Mtesa, on the shores of Lake Victoria Nyanza. According to Col. Long's account, he left Gondokoro on the 24th of April last, charged by Col. Gordon with a friendly mission to the powerful King of Uganda (King Mtesa), and accompanied by two Egyptian soldiers and two servants. The journey occupied fifty-eight days, at the end of which the party was rewarded by the sight of the richly-cultivated central district of Uganda, appearing like a great forest of bananas. King Mtesa received the envoy with great friendliness, and ordered thirty of his subjects to be decapitated in honour of the visit. Permission was given Col. Long to descend "Murchison Creek" and view Lake Victoria. The journey from Mtesa's residence occupied three hours, and the party embarked on canoes made of the bark of trees, sewn together. Col. Long sounded the waters of the lake, and found a depth of from 25 to 35 feet. In clear weather the opposite shore was visible, appearing "to an unnautical eye" from twelve to fifteen miles distant; he did not think he could possibly be greatly deceived in this estimate. After much negotiation and, opposition, he obtained permission to return to Egyptian territory by water, and on the way, in lat 1·30, discovered a second lake, or large basin, at least twenty to twenty-five miles wide. He found the Upper Nile from Ripon Falls to Karuma Falls a fine navigable stream large enough for the *Great Eastern*. He finally reported from Gondokoro (October 20) that Col. Gordon would soon have a steamer on Albert Nyanza, and intended also to move one to the Upper Nile above Karuma.—A paper was then read "On a Journey along the East Coast of Africa, from Dar-es-Salam to Kilwa, in December 1873, by Capt. F. Elton," the chief point of which was that the Rufigi River was found above the head of the delta to have an average depth of only four to five feet.—Major Erskine (late Colonial Secretary of Natal) then read a paper on his son's (Mr. St. Vincent Erskine) recent mission to the powerful Kaffir chief Umsila, whose territory stretches along the richly-wooded and fertile interior country between the Limpopo and the Zambezi. Umsila's head-quarters are near the ruins of Zimbaye, where the German traveller, Carl Mauch, discovered sculptured stones, supposed by some to be of great antiquity. Major Erskine stated that his son had just returned from a second visit to Umsila and Sofala.

PARIS

Academy of Sciences, Jan. 4.—M. Frémy in the chair.—The following papers were read:—Note on magnetism *à propos* of a recent communication by M. Lallemand, by M. Th. du Moncel.—Memoir on the resistance of protozoids to the different dressing materials employed in surgery, by M. Demarquay.—On the decomposition and preservation of wood, by M. Max. Paulet.—On the germination of the "Chevallier" barley, by M. A. Leclerc.—Communications relating to Phylloxera were received from MM. L. Roesler, G. Beaume, P. Jolly, and others.—The French Minister in China forwarded a despatch from M. Fleuriais, dating from Shanghai, Dec. 26, and announcing the successful result of the Transit of Venus observations.—The following letters from various observing stations were also read:—From MM. Ch. André and A. Angot, at Noumea, dated Oct. 8; from M. J. Janssen, at Nagasaki, dated Nov. 4; from M. Héraud, at Saigon, dated Nov. 22; and from M. P. Tacchini, at Muddapur (Bengal), dated Dec. 10. This last communication makes known that the spectroscopic observations of the Transit were satisfactory, and tend to show that the diameter of the sun is smaller when seen in the spectroscope than when observed by the other method.—On the calculus of geodesic co-ordinates, by M. Ch. Trepied.—On the expression of work relative to an elementary transformation, by M. J. Moutier.—Analogies between the disengagement of gases from their supersaturated solutions and the decomposition of certain explosive bodies, by M. D. Gernez.—On the atomic structure of the molecules of benzene and terebene, by M. G. Hinrichs.—On the titanic ethers by M. E. Demarcay. One molecule of titanic chloride is mixed in small portions with four molecules of absolute alcohol, and the mixture heated to 80°–100° *in vacuo*, when hydrochloric acid and the excess of alcohol are removed and a crystalline mass obtained which has the composition of the chlorhydrate of monochlorhydrine, $Ti(OC_2H_5)^3Cl,HCl$. This body forms white crystals, melting at 105°–110°, and decomposable by water. Sodium ethylate dissolved in excess of alcohol is added to an alcoholic solution of the chlorhydrate, when sodium chloride is precipitated, and the alcoholic solution yields on evaporation white crystalline needles of the ether $Ti(OC_2H_5)^4$.—On the pyruvic ureides: Condensed ureides; by M. E. Grimaux. The author now considers dipyruvic triureide, $C_9H_{12}N_6O_5$; tetrapyruvic triureide, $C_{15}H_{14}N_6O_8$; and dipyruvic tetraureide, $C_{13}H_{16}N_8O_7$.—On the shooting stars of November 13 and December 10, 1874, by M. Gruey.—Aërial corpuscles and saline matters contained in snow, by M. G. Tissandier.—Researches on the gastric juice, by M. Rabuteau. The author's experiments confirm the results obtained by Braconnot, Prout, Lassaigne, and Schmidt—that the acidity of the juice is due to hydrochloric and not to lactic acid.—On the nature of syphilitic affections, and on mercurial treatment, by M. J. Hermann.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—The Microscope and its Revelations: Wm. B. Carpenter, M.B., LL.D (J. and A. Churchill).—The Apparent Absence of Air and Water from the Moon: Francis Rapier (Philosophical Society of Glasgow).—Some Reasons for doubting the Alleged Transit of Venus (Hodder and Stoughton).—Report of the Kew Committee, for year ending Oct 31, 1874.—Remarks on the Great Logarithmetic and Trigonometrical Tables computed in the Bureau du Cadastre under the direction of M. Prony: Edward Sang.—A Short History of the English People: Rev. J. R. Green, M.A. (Macmillan and Co)—The Amazon and Madeira Rivers: Franz Keller (Chapman and Hall).—Chemical and Geological Essays: T. Sterry Hunt, LL.D. (Trübner).—The Transit of Venus; its Meaning and Use: T. H. Rudd, F.R.A.S. (Longmans).—Two Years in Peru, with Exploration of its Antiquities: Thos. J. Hutchinson, F.R.G S., F.R.S.L., M.A.I., &c. (Sampson Low, Marston, Low, and Searle).

AMERICAN.—Report of the Commissioner of Fish and Fisheries of the United States, 1872–73 (Washington).—Memoirs of Boston Society of Natural History: The Species of Lepidopterous Genus Pamphila: Samuel H. Scudder (Published by the Society).—Report of the Medical Commission upon the Sanitary Qualities of the Sudbury, Mystic, Shawstone, and Charles River Waters (Boston, Rockwell and Churchill).—Results derived from an Examination of the United States Weather Maps for 1872–73: Elias Loomis (From American Journal of Science and Arts).—Jeffries Wyman Memorial Meeting of the Boston Society of Natural History.

COLONIAL.—Appendix to New Vegetable Fossils of Victoria: Baron Ferd. von Mueller, C.M.G, M.D., Ph D., F.R.S.—Journal of the Asiatic Society of Bengal (G. H. Rouse, Calcutta).—Proceedings and Transactions of the Nova Scotian Institute of Natural Science (Wm. Gossip, Halifax, N.S.)—Durability of New Zealand Timber (Report read by Mr. Thomas Kirk).

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DIARY OF SOCIETIES.

LONDON

THURSDAY, JANUARY 14.

Royal Society, at 8.30.—On a Class of Identical Relations in the Theory of Elliptic Functions: J. W. L. Glaisher.—On some Remarkable Changes produced in Iron and Steel by the action of Hydrogen and Acids: W. J. Johnson.

Society of Antiquaries, at 8.30.—Monumental Brasses of the County of Bedford: A. W. Franks, F.R.S.

Royal Institution, at 3.—Physical Geography: Prof. P. M. Duncan.

London Mathematical Society, at 8.—The Solution of Linear Differential Equations in Series: J. Hammond.—On the Potential of the Ellipse and the Circle, and Determination of the Attraction of an Ellipsoidal Shell on an Exterior Point: Prof. Cayley, F.R.S.—Construction of a Slide Scale: Major J. R. Campbell.—On the Representation of any Unicursal Curve and its Nodes in terms of the Parametric Coefficients and on Roberts' and Hart's cases of Unicursal 3-Bar Motion: J. J. Sylvester, F.R.S.

London Institution, at 7.—Early Inhabitants of England; Prof. Rolleston, F.R.S.

Gresham Lectures, at 7.—The Sense of Smell: Dr. E. S. Thompson.

FRIDAY, JANUARY 15.

Royal Institution, at 9.—Acoustical Problems: Prof. Tyndall, F.R.S.

Medical Microscopical Society, at 8.—Annual General Meeting.

Gresham Lectures, at 7.—On Catching Cold: Dr. E. S. Thompson.

SATURDAY, JANUARY 16.

Royal Institution, at 3.—Mozart: Mr. Dannreuther.

Physical Society, at 3.

SUNDAY, JANUARY 17.

Sunday Lecture Society, at 4.—John Stuart Mill and his Critics: Miss Fenwick Miller.

MONDAY, JANUARY 18.

Society of Arts, at 8.—Cantor Lecture; Alcohol, its Action and Use: Dr. B. W. Richardson, F.R.S.

London Institution, at 5.—Life-History of Plants and Animals: Prof. Armstrong.

Victoria Institute, at 8.—On some Remarks on Teleology and Morality by Prof. Huxley: Rev. G. Henslow.

TUESDAY, JANUARY 19.

Zoological Society, at 8.30.—Descriptions of twelve New Species of Shells from the Collection of Mr. C. Coxen, of Brisbane, Queensland: John Brazier, C.M.Z.S.—Descriptions of four New Species of Protogonius: A. G. Butler.—Descriptions of some New Species of South American Birds: Messrs. P. L. Sclater and O. Salvin.

Royal Institution, at 3.—Pedigree of the Animal Kingdom: E. Ray Lankester.

Statistical Society, at 7.45.

WEDNESDAY, JANUARY 20.

Meteorological Society, at 7.—Annual General Meeting.

Society of Arts, at 8.

THURSDAY, JANUARY 21.

Linnean Society, at 8.—On the Pathology of Oak-Galls, &c.: Dr. Hollis.—On the Nature of several Atolls in the South Pacific: Rev. T. Powell.—Papers on the Botany and Entomology of the *Challenger*.

Royal Institution, at 3.—Physical Geography: Prof. P. M. Duncan.

London Institution, at 7.—Early Inhabitants of England: Prof. Rolleston, F.R.S.

TORQUAY

MONDAY, JANUARY 18.

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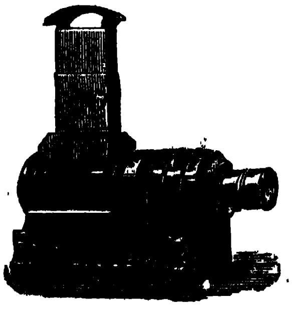

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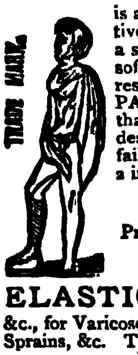

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THURSDAY, JANUARY 7, 1875

THE GEOLOGICAL SURVEY OF VICTORIA

Geological Survey of Victoria. Prodromus of the Palæontology of Victoria; or, Figures and Descriptions of Victorian Organic Remains. Decade I. By Frederick M'Coy, F.G.S., Government Palæontologist, and Director of the National Museum of Melbourne. (Melbourne: John Frères. London: Trübner and Co., 1874.)

WE have at last a first instalment in the shape of a Decade, from Prof. M'Coy, of Melbourne, Australia, upon the organic remains of that colony. It is entitled, "Prodromus of the Palæontology of Victoria, or Figures and Descriptions of Victorian Organic Remains," Decade I. The preface, by Prof. M'Coy, states that as the maps and sections of the Australian Survey would be incomplete without figures and descriptions of the fossil organic remains, it has been determined to issue a Prodromus or preliminary publication of the Victorian fossils, in decades or numbers of ten plates each, with descriptive letterpress. The first decade contains matter illustrating six different groups of fossils; viz., the Graptolites, the Marsupiata, the Mollusca (Gasteropoda), gymnospermous and lycopodiaceous plants, and Star-fishes of the family Urasteridæ. We presume that this mode of issuing the decade is an experimental one, as it will require eight or ten numbers of decades to complete one decade of a particular group, depending upon the number of plates devoted to these particular groups as they are issued. We should have preferred seeing a decade on the Graptolitidæ completed at once, or the Asteriadæ, or Volutidæ, or indeed any other, thus forming almost a monograph of some special group, as a connected whole, as it will be long before a decade of any one group can be hoped for, unless the Professor has a large stock in hand, and store already prepared. If there is one group more interesting than another, figured in the decade, it is the Graptolites: the Victorian species figured are nearly all British, European, and American; no extinct organisms of apparently the same species had so wide a distribution in space. Hall, of America, Carruthers, Hopkinson, Lapworth, Nicholson, Baily, &c., have all elaborately written (indeed still are writing) upon these mysterious Hydrozoa; and Prof. M'Coy, of Victoria, and Etheridge, of Edinburgh, are now investigating the Victorian forms. Surely something definite may be expected, or will be determined, as to their specific value. Monoprionidian forms of the genus Diplograpsus and Didymograpsus are the only genera touched upon in the decade; also one Phyllograptus, *P. folium*, var. *typus* Hall, which differs little from our British species, except in being larger. M'Coy describes ten species, four of which are British of Lower Silurian age. Our own gold-bearing Cambrian slates of North Wales thus contain a fauna, the same in time as those "goldfield slates" of our auriferous colony.

Plates 3, 4, and 5 of the decade and text are devoted to descriptions of the mandibulæ or jaws of one genus of marsupial mammalia of Australia, *Phascolomya pliocenus* (Wombat). The mandibles only are figured and described. The chief interest attached to this fossil arises from its being the first ever found in the Victorian ferruginous gold drifts or gold cement of Dunolly. Prof. M'Coy fixes the age of the deposit as Pliocene Tertiary, corresponding in time with our upper crags of Norfolk and Suffolk, and he believes the Victorian beds correspond in age with the gold drifts of the Ural chain.

Macropus titian and *M. atlas*, extinct forms of Kangaroo, occur with this fossil form of Wombat. We look forward to much original matter from Prof. M'Coy upon the phytophagous and carnivorous marsupials of the Australian continent.

Plates 6 and 7 of the Volutidæ, especially certain forms, are scarcely distinguishable from the Middle Eocene species of our own country (Barton and Bracklesham); and the higher Oligocene Tertiaries of Europe are represented in these distant Cænozoic deposits of the antipodes. The *Voluta anti-cingulata* of M'Coy seems to us to realise the alliance of our two British species—*V. ambigua* and *Voluta digitalina*. We have again a representative form in *V. antiscalaris*, M'Coy, occurring in the Tertiary and Oligocene clays of Modop and Mount Martha. The *Vololithes scalaris*, Sow. (Middle Eocene of Isle of Wight and Barton) and the *Voluta nodosa*, Sow. (Bracklesham and Barton) are so closely allied to those Australian Volutes that we fail to see any difference; they are truly representative. The remarkable shells, *V. macroptera*, M'Coy, and *V. Hannafordi*, M'Coy, are essentially new forms, and throw fresh light upon the specific value of the genus; the great expansion and globose nature of the wing or lip removes it from our British Crag *Voluta Lambertii*, but to which in many other respects it is allied.

Part VIII. with Plate 8 is devoted to the description of eight species of Zamites (Podozamites). This group of gymnospermous plants are of much interest to the palæophytologist, and, in this country and Europe, essentially typify and characterise rocks of Secondary or Mesozoic age. The discovery in Queensland of a bipinnate or distichous Zamia (Bowenia) has changed our views as to the foliage of this group of Cycadaceæ, now known to be compound instead of simple. M'Coy proposes the sub-generic name of *Bowernites* for these compound fossil Cycadaceæ resembling the recent Bowenia. The fruit found with the remains does not aid the Professor in determining their true affinity, but he states they more strongly resemble the fruit of the fossil Zamiæ of our Yorkshire oolites than the Araucarian type. The fossil or extinct British Cycadaceæ had long range in time, commencing in the Lias and living through all the Secondary rocks; Fittonia, of the Upper Cretaceous beds, being the last British form. The group is largely represented by many species in our Wealden and Purbeck rocks.

Part IX. and plate accompanying it illustrate one genus of lycopodiaceous plants (Lepidodendron). This ubiquitous genus occurs in the coal measures in every region of the globe, and frequently in the Upper Devonian rocks, but at the close of the Palæozoic period passed away. There is much conflicting evidence and information relative to the occurrence of this group of lycopods in the true coal measures of New South Wales and Victoria. Prof. M'Coy states that not one has ever yet been found in the coal strata of New South Wales or Victoria; its occurrence in both areas named is entirely unconnected with the beds yielding the coal. M'Coy believes that the coal-yielding rock of the above localities are of Mesozoic age; stating his reasons from the entire absence of Calamites and Lepidodendrons, and from the presence of Tænioptera, Phyllotheca, and other forms intimately related to those of the Mesozoic coal-beds of the oolitic formations of Yorkshire, Europe, Richmond (America), and India. That rocks of true Coal-measure age do occur in Australia there is no doubt; we cannot here discuss the fragmentary and conflicting evidence of its presence and distribution until more reliable data has been collected.

Plate 10 illustrates two species of star-fishes from the Upper Silurian rocks, Pteraster and Urasterella, both of the family Urasteridæ. M'Coy's Urasterella is the Stenaster of Billings and Palæaster of Hall; and to this latter genus have been referred those forms of old star-fishes having adambulacral, ambulacral, and marginal plates on the arms, whereas Urasterella differs in only having one row of plates on each side of the ambulacral groove. The two forms figured in the decade are named after the present mining and late geological directors of the colony. *U. selwynii* appears to be the first fossil star-fish found in Australia. These star-fishes, like many other Australian fossils, are almost identical with our British types. We know of no more remarkable fact in the history and distribution of life than the affinity that seems to exist between the forms of life over two areas so old and so vastly removed as that of Britain and Australia, antipodal to each other; universality might almost be applied through Homotaxis to the geographical distribution of the several formations which comprise the periods even stratigraphically and lithologically; as well as the existence in common of numerous genera, and with many representative and some even identical species between the two countries. What difference in time there might have been between the deposition of the sedimentary materials and its accompanying life in our European or the American area, with that of the Australian region, we shall never know; but the faunal relations were nearly the same, and the then species must have had a far wider distribution in space and time than we have hitherto imagined or generally believed.

This first Decade of Victorian Fossils will be studied with much interest by British palæontologists, firstly on account of its being from the pen of the accomplished Director of the National Museum of Melbourne, and secondly on account of the valuable researches and matter forwarded to us illustrating the palæontology or past life history of that remote region of the globe.

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THE Loangwa was crossed on December 15, and on Christmas Day Livingstone lost his four goats, a loss which he felt very keenly; "for, whatever kind of food we had, a little milk made all right, and I felt strong and well, but coarse food, hard of digestion, without it, was very trying." Indeed, after this Livingstone suffered much from scarcity of food, and became greatly emaciated and weakened; and to intensely aggravate this, through the weakness of a boy and the knavery of a runaway slave, the medicine chest was stolen on January 20, 1867, a loss which was utterly irretrievable. "I felt," he sadly says, "as if I had now received the sentence of death, like poor Bishop Mackenzie." Fever came upon him shortly after, and for a time became his almost constant companion; this, with the fearful dysentery and dreadful ulcers and other ailments which subsequently attacked him, and which he had no medicine to counteract, no doubt told fatally on even his iron frame, and made it in the end succumb to what he might otherwise have passed through with safety.

The Chambezi, whose course into Bangweolo Livingstone has finally determined, was crossed on January 28. While detained for about three weeks at the village of Chitapangwa, a somewhat able and on the whole well-meaning chief, he sent off a packet of letters and despatches with some Arab slaves; these reached England in safety. He also sent forward a small supply of provisions to Ujiji. At last the southern shore of Tanganyika (or Lake Liemba, as the south part is called) was reached on March 31. By this time Livingstone was so weak, he could not walk without tottering. At the village of Chitimba, some distance west of the end of the lake, he was detained for upwards of three months, on account of a quarrel between a chief, Nsama, and the Arab Kamees, whom Livingstone found here with a slaving party, and who showed the traveller much kindness. On Aug. 30, difficulties having been adjusted, Livingstone proceeded westwards, and on Nov. 8 came upon the north end of Lake Moero, "a lake of goodly size, flanked by ranges of mountains on the east and west. Its banks are of coarse sand, and slope gradually down to the water; outside these banks stands a thick belt of tropical vegetation, in which fishermen build their huts. The country called Rua lies on the west, and is seen as a lofty range of dark mountains."

Proceeding southwards, Cazembe's, on Lake Mofwe, a lakelet a little south of Moero, was reached in a few days. The name of Cazembe is already known in connection with the journey, in the end of last century, of Dr. Lacerda, who died and was buried not far from the present village. This Cazembe (he was killed shortly after Livingstone's visit) was the tenth from the founder of the dynasty, who came from Lunda, and conquered the then reigning chief, usurping the chiefship. Cazembe treated Livingstone on the whole handsomely. The traveller remained at his village about a month, when he again went to the north of Lake Moero, and visited the Lualaba, the river which, rising in Lake Bangweolo as the Luapula, and of which the Chambezi may be considered the beginning, stretches away northwards and westwards through Lake Kamolondo, and again northwards, to what termination is not yet known. Livingstone had a firm belief that it was the upper part of the Nile, though appearances would seem to suggest that it more probably joins the Congo. There is every likelihood that Lieut.

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* Continued from p. 145.

Cameron will be able ere long to solve the mystery. To this river Livingstone has given the name of his friend Webb, and to an important tributary from a reported large lake to the west, named by Livingstone Lake Lincoln, and made to join Lualuba about 3° S. lat., he has given the name of his staunch friend "Sir Paraffin Young." Livingstone again came south to Cazembe's in May 1868. Before this all but five of his men deserted to a slave party under Mohamed bin Saleh, who had been detained ten years at Cazembe's, and whom Livingstone helped to get off. He turned out an ungrateful cheat. Continuing southwards in June, Livingstone on July 18 reached Lake Bangweolo, although he was not really its first European discoverer, the Portuguese having been there long before him. With difficulty obtaining a canoe, he crossed to an island some miles off the north-west corner of the lake. The latter he calculates to be about 150 miles long by 80 broad, and is 3,688 feet above the sea. It, as well as Moero, abounds in fish of a great variety of kinds, some of which, no doubt, will ultimately be found new to science. Livingstone had no means of bringing away any specimens, and only gives the native names. As we have said, the north-east, east, and south sides of the lake are surrounded with "sponges," the water in many places being so deep as to require canoes, and is intersected by the courses of many streams. On islets in this sponge the villages are located.

In connection with this "sponge" and the rainy season, Livingstone enters in this part of his journal on a long disquisition on the climate of Central Africa, which we recommend to the notice of meteorologists. Speaking of the region around Bangweolo, he says "burns (*Scoticè* for 'brooks') are literally innumerable: rising on ridges, they are undoubtedly the primary or ultimate sources of the Zambezi, Congo, and the Nile; by their union are formed streams of from thirty to eighty or one hundred yards broad, and always deep enough to require either canoes or bridges. These I propose to call the secondary sources, and as in the case of the Nile they are drawn off by three lines of drainage, they become the head waters (the *caput Nili*) of the river of Egypt." No one had a better right to theorise on this subject than Livingstone, for few had observed so much; but it may yet be found that he allowed his eagerness to settle the Nile question to run away with his cooler judgment.

After being detained near Bangweolo for some time by the disturbed state of the country, he proceeded northwards in the company of some Arab traders. Still further delay occurred to the north of Moero, caused by the barbarity of the Arab slavers with whom he was compelled to travel, and it was not till December that a start in earnest was made north-eastwards to Tanganyika. He became so ill on the road with pneumonia and other ailments, resulting from damp and a completely enfeebled constitution, that he became insensible and had to be carried part of the way. The effects of this illness never left him. The lake was reached in February 1869, and Livingstone entered Ujiji on March 14, a "ruckle of bones." Supplies had been forwarded to him here from Zanzibar, but his misfortunes were aggravated by finding that most of them had been knavishly made away with by those to whose care they had been entrusted.

The traveller re-crossed Tanganyika in July, and on August 2 set out on a new series of discoveries to the west of the lake, in a region not before visited, scarcely even by the Arabs, that of the Manyuema. Through this region flows into the Lualaba the large river Luamo, or Luasse, or Lobumba, rising close to the west shore of Tanganyika. Livingstone's object was to reach the Lualaba and if possible cross to the west side. After vainly trying to get west, he went into winter quarters in February 1870, at Mamohela, in about 4° 20′ S. lat. and 27° 5′ E. long. Another attempt was made to reach the river with only Chuma, Susi, and Gardner. He was again baffled and returned to Bambarre, south-west of Mamohela, in July, martyred with irritable eating ulcers in the feet, which seem to be caused by some form of malaria, and with which he was for long sorely troubled; he was confined to his hut for eighty days with them. During his long detention here, which galled Livingstone dreadfully, he records many observations of the people, who certainly seem to eat human flesh, and prefer it when very "high," but who were on the whole extremely kind to himself, notwithstanding the brutal usage given them by the Arab traders, with whom the country now swarmed, and who mercilessly burned villages and slaughtered men, women, and children, simply to inspire terror. Here Livingstone became acquainted with what Mr. Waller thinks is an entirely new species of chimpanzee, a remarkable animal called by the natives the "Soko," possessing wonderful intelligence and having some very curious habits. In February 1871, some men who proved worthless scoundrels reached him from the coast, and he again started for the Lualaba, which at last he reached on March 29. He stayed at a village, Nyangwe, for four months, vainly trying to get a canoe to take him to the other side, which was here 3,000 yards off, the bed of the river being dotted with many islands. This Nyangwe at which Livingstone stayed is a place of great interest; a regular market is kept daily to which hundreds of women from the other side flock to buy and sell goats, sheep, pigs, slaves, iron, grass cloth, salt fish, earthen pots, &c. The devilish treachery of the Arab slavers seems to have reached its height here during Livingstone's sojourn. A party under one Dugumbé, without warning or provocation, assembled one day when the thronged market was at its height, and commenced shooting down the poor women right and left, so that between those who were shot and those who were drowned, hundreds were killed, and the market completely broken up. No wonder that Livingstone had "the impression that he was in hell," and that his "first impulse was to pistol the murderers." This of course completely knocked on the head any chance which he may have had of getting a canoe, and in sickening disgust he made his way back to Ujiji, which he reached on October 23. While returning through Manyuema, his party was attacked by the enraged people, who mistook Livingstone for one of the slavers, and nearly stopped his further travels by a spear which grazed his back. This was the only time during these last seven years' wanderings that the traveller was hostilely attacked. Five days after his arrival at Ujiji he was cheered and inspired with new life, and completely set up again, as he said, by the timely arrival of Mr. H. M. Stanley, the richly-laden almoner of the proprietor of the *New York Herald*. Mr. Stanley's story is known to everyone, and we need not repeat it.

With Stanley, Livingstone explored the north end of Lake Tanganyika, and proved conclusively that the Lusize runs into and not out of it. It will be satisfactory if the discovery of an outlet on the west side, just announced in a despatch from Lieut. Cameron, turns out to be true. In the end of the year the two started eastward for Unyanyembe, where Stanley provided Livingstone with an ample supply of goods. Here Stanley urged his going home, but although he was now inwardly yearning to return, his judgment said, "All your friends will wish you to make a complete work of the exploration of the Nile before you retire." To this purport also was the advice of his daughter Agnes, whom he therefore calls "a chip of the old block." But had his judgment been cool enough, it might have told him that his constitution was so shattered that it was totally unequal to a task of such magnitude. The fountains he was in search of he supposed to be about 400 miles to the west of Lake Bangweolo.

The rest is soon told. Stanley left on March 15, and after Livingstone had wearily waited in Unyanyembe for five months, on August 15 a troop of fifty-seven men and boys arrived, some of the boys being Nassick pupils from Bombay, one of whom was Jacob Wainwright, who afterwards acted so important a part in the home-bringing of his body. Thus attended, then, he started on August 25 for Lake Bangweolo, proceeding along the east side of Tanganyika, over rugged mountains which sorely tried the endurance of himself and his retinue, even though he had two donkeys to ride, a present from Mr. Stanley. His weakness soon found him out; ere he reached the shore of Tanganyika his old enemy dysentery seized upon him, and seems never wholly to have left him, but to have got worse and worse, causing him fearful suffering till the bitter end. In January 1873 the party got among the endless spongy jungle on the shores of Bangweolo, where vexatious delays took place, and where the journey was one constant wade below, and under an almost endless pour of rain from above. The Chambezi was crossed on March 26, and the doctor was getting worse and worse, losing great quantities of blood daily: but he seems never to have dreamed of turning back or of resting. No idea of danger seems to have occurred to him; he had so often before got over difficulties and attacks of all kinds, and he was so full of the object his heart was bent on, that the idea of death does not seem to have entered his head. This, we believe, moreover, is a characteristic of the disease. At last, in the middle of April, he was unwillingly compelled to allow his men to make a *kitanda*, or rude litter, in which he was borne to the end. Still the dreadful illness is spoken of as a mere annoying hindrance. Thus, on the 29th of April, Chitambo's village on the Lulimala, on the south of the lake, was reached. The last entry in the journal, of the last two pages of which a fac-simile is given, is April 27: "Knocked up quite, and remain—recover—sent to buy milch goats. We are on the banks of the Molilamo." On April 30 he was careful to wind his watch, but with the utmost difficulty, and early on the morning of May 1 he was found by the boys kneeling by the side of his bed, dead.

Chitambo behaved generously, and the men, headed by Chuma and Susi, acted with great intelligence, faithfulness, and discretion. Everything was carefully locked up, and the story of the preparation of Livingstone's body for the purpose of carrying it home to his own folk, by "beekin' forenent the sun," is known to all. After a five months' march through many difficulties, the attendants reached Unyanyembe. Here Lieutenants Cameron and Murphy and Dr. Dillon were met, and early this year the body arrived at Zanzibar, and in the end of April was deposited, as was meet, in Westminster Abbey.

A monument with an appropriate inscription has been erected to Livingstone in the Abbey; and doubtless, in time to come, a more suitable memorial will take the place of that rude one placed near the spot where their hero died, by the hands of his loyal and faithful attendants.

Mr. Waller, we think, has on the whole performed his sacred task judiciously, printing the journals, as we have said, exactly as he found them, though many of his parenthetical remarks seem to us unnecessary. The maps are of great assistance to the reader, and will be found ot value to the geographer, although in the meantime, so far as Livingstone's last journey is concerned, they must be regarded as to a great extent conjectural. No doubt careful criticism will soon do its work both on journal and maps, and, with the help both of previous and subsequent exploration, test the exact geographical value of the achievements which cost Livingstone his life. The illustrations are interesting and helpful.

BUCHANAN ON THE CIRCULATION OF THE BLOOD

The Forces which carry on the Circulation of the Blood. By Andrew Buchanan, M.D. Second Edition. (London: J. and A. Churchill, 1874.)

IN the same way that, among *à priori* mechanical philosophers, the possibility of discovering a perpetual motion was a favourite subject of discussion before the development of the theory of energy, so, among physiologists, the relative importance of the different forces which maintain the circulation of the blood was an equally common source of speculation before the introduction of the blood-pressure gauge and the sphygmograph. Within the last twelve or fifteen years, however, the various problems which used to occupy the attention of Magendie, Arnott, and Barry have been completely solved by entirely fresh methods of observation; and these, quite irrespective of their *opinions*, have verified or disproved their theoretical deductions according to whether or not they were based on sound premises.

Dr. Buchanan devotes much of the short work before us to the consideration of one of these bygone points, namely, the pneumatic forces which maintain the circulation of the blood, the importance of which he endeavours to demonstrate by a series of hydraulic experiments, the different elements of which are, we fear, slightly savoured with the bias of preconceived notions, as the result at which he arrives is that "after birth the circulation is mainly carried on by two forces—the propulsive force of the heart and the pressure of the atmosphere, acting nearly in the proportion of three of the former to two of the latter; but that as life advances, and the quantity of venous blood increases, the latter force becomes relatively more powerful." The most energetic of these auxiliary pneumatic forces is stated to be that of the chest, which is followed in importance by the suction force of the heart and by a "pleuro-cardiac pneumatic force," in which the heart, contracting in a rigid chamber, draws blood into it from the surrounding veins, on account of its decrease in size during the systolic act. The elaborate investigations of MM. Chauveau and Marey,* published a little more than ten years ago, put us in a position to state exactly, in inches of mercury, what are the values of the pneumatic forces which Dr. Buchanan describes; and as these results are evidently not familiar to British physiologists, to those at Glasgow at least, it may be worth while recapitulating them here. First, the sphygmograph trace in health shows that, as Dr. Arnott maintained, normal respiration has scarcely any appreciable effect on the blood-pressure, because the horizontal line joining corresponding points in the different pulse-beats is very nearly, if not quite, straight. These authors also explain how the antagonistic results of Ludwig and Vierordt—in which the one states that the blood-pressure falls during inspiration, and the other during expiration—can be accounted for; they finding that if the air-passages are partially obstructed, as by shutting the mouth and closing one nostril, the one result is produced; whilst if these same passages are freely opened, the opposite effect is observed. The influence of respiration may therefore be dismissed as comparatively insignificant.

That of the heart is much more considerable. By means of a beautifully constructed piece of apparatus M. Marey has been able to demonstrate the existence and amount of the negative or suction forces, as far as they are found to exist in the different cavities of the heart, during the different parts of each cardiac pulsation. His results are recorded by the graphic method,† and their agreement among themselves is evidence of their accuracy. The work referred to contains a full description of the apparatus employed. The following are the results:—In the right ventricle the blood-pressure does not ever go beyond zero, except at its basal portion, where it is *sometimes* found that a minute suction force develops immediately after the closure of the aortic valves, and then only. In the left ventricle an appreciable suction force is observed at the same time as in the right; it is, however, not great. It is impossible, by any means yet devised, to get at the left auricle, but the right auricle is easily arrived at from the jugular vein. In it the blood-pressure is *nearly always* negative or below zero, it being otherwise only during its systole. A study of the auricular cardiograph trace shows that immediately after the auricular systole, which is the same thing as saying at the commencement of the contraction of the ventricles, the pressure in the auricle descends rapidly below zero; that the descent is broken by a small wave, and that the suction force commences to diminish gradually after the closure of the aortic valve, becoming *nil* a very short time before that organ again contracts. The explanation of these changes is not difficult. The rapid fall in the auricular pressure during the ventricular contraction was many years ago fully explained in a peculiarly able memoir by Mr. Bryan,* and the active dilatation of the ventricles of the heart during diastole, which necessitates a corresponding internal suction force, has been shown by more than one physiologist to depend on the peculiarities of the coronary circulation.

By employing a specially adapted manometer M. Marey was able to measure this suction force in the right auricle of *Equus caballus*, and found that it ranges, on the average, between – 7 and – 15 millimetres of mercury, the same method giving 120 millimetres as the average pressure in the left ventricle during the systole. From these figures the true relation borne by the contractile force of the heart to its suction power can be readily estimated.

The "pleuro-cardiac pneumonic force" described by Dr. Buchanan is nothing more than that above referred to as described by Mr. Bryan, the latter author having previously demonstrated that on account of the heart—a conical organ—contracting in a conical cavity, it must necessarily advance towards the apex of that cone during systole, and so leave the base to be filled by the absorption of the blood from the distended veins.

These remarks all tend to show that many of Dr. Buchanan's investigations are in the right direction, but that a further acquaintance with the literature of the subject would enable him to employ his considerable ingenuity and enthusiasm in the elucidation of points still remaining unexplained to students of the science of physiology. This want of acquaintance with the works of others is, we think, partly explained by some incidental remarks in the book before us. The author says: "I have always exercised all the branches of my profession. . . . I cannot but regard this custom as much superior to that which our medical corporations are now enforcing, of making every man from the beginning select for himself a single branch of the profession;" to which are added other remarks derogatory to specialisation in study. With these we cannot agree, and still think that "if you wish to find a man of large views of physiological nature," he is more likely to be a special student, with time at his disposal, unoccupied by miscellaneous professional calls, than one who, turning his attention to all things, has no opportunity of concentrating it on any one, to the advancement of our knowledge of its details.

OUR BOOK SHELF

Elements of Animal Physiology. Elementary Science Series. By J. Angell. (W. Collins and Co., 1874.)

THERE is more than one way by which the relative importance of scientific facts may be arrived at. An investigator, whilst prosecuting his independent researches, will not be long in forming a fairly accurate standard, and this he finds it easy to impart to others. Many engaged in educational work find it impossible to afford the time for independent observation or prolonged study, and yet it is their ambition to give their pupils a fairly correct estimate as to those of the innumerable facts surrounding them on which they should lay stress in preparing for a pass examination. The standard with them therefore becomes nothing more nor less than the questions of former years or of other similar examinations; the work which answers the greatest number of these in the most satisfactory manner being looked upon as the most valuable, especially if the irrelevant matter is reduced to a minimum. The small book before us contains a carefully compiled and accurate digest of many of the most prominent facts of human physiology, with incidental references to some of the best known peculiarities of a few of the lower animals, illustrated by several appropriate and well-selected diagrams, among which, however, there is an important one indicating the general distribution of the arterial system, which is unfortunately reversed, and another explaining the leverages of the body, representing a man as standing with his centre of gravity far in front of the tips of his toes. The language employed is clear and concise, whilst many of the best known terms in common use among physiologists are explained in a glossary at the end of the book. Some of the practical illustrations suggested to the pupil for his own instruction are particularly to the point. There are some explanations with which, however, we cannot agree, such as that the activity of the circulation of the blood which accompanies physical exercise is the result of the alternate compression and relaxation of the veins; and that a much vaunted theory as to the cause of cholera, which involves the purchase of a much advertised apparatus for its relief, has sufficient foundation for even the slightest mention in any book for the use of students. The non-technical character of the work will commend it to many as a useful introduction to physiology.

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* Marey, "Circulation du Sang;" Paris, 1863.

† *Loc. cit.* pp. 95, 96.

* *Lancet*, Feb. 8, 1834.

The Gardener's Year Book and Almanack, 1875. By Robert Hogg, LL.D., F.L.S. (*Journal of Horticulture* Office.)

THIS is a very handy and valuable little book. The information it contains is of a kind that may be thoroughly depended upon. Besides a great deal of practical information of a miscellaneous sort, there are tolerably copious gardening directions for each month, besides selected lists of fruits and vegetables, and of the new plants of last year. It will be very useful to amateur gardeners, and would be still more so if it gave some short and plain descriptions of various horticultural operations—such, for example, as pruning different kinds of fruit-trees.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Absence of Microscopic Calcareous Organic Remains in Marine Strata charged with Siliceous Ones

IN a letter headed "Deep-Sea Researches," and subscribed "W. C. Williamson, Owens College," in your issue of the 24th Dec. (vol. xi. p. 148), the author, after having stated that Dr. Wyville Thomson has come to the conclusion that the calcareous Globigerinæ and other such elements had been removed by the "solvent action of carbonic acid accumulated in the deep-sea waters," adds that, "In my memoir [1847, *op. cit.*] I arrived at the same conclusion."

Then follow extracts from the "Memoir" itself, alluding to the removal of all the calcareous forms, leaving only the siliceous structures," by "carbonic acid gas in solution in water."

Finally, the author states:—"After venturing upon these conclusions in 1847, not as mere speculative guesses, but as the deliberate result of a long series of investigations carefully worked out, I need scarcely say how intense was the interest with which I read Dr. Wyville Thomson's observations, which so thoroughly sustain and confirm the accuracy of mine. My conclusions were wholly derived from the microscopic observations of earths and rock specimens which I compared with the few examples of foraminiferous ooze with which I was then familiar."

"Felix qui potuit rerum cognoscere causas."

In enumerating the different kinds of destruction which take place in sponge-spicules generally, I have noted that the calcareous spicule is subject to one in particular, "in which there is a general breakdown of the whole fabric, which gradually becomes resolved into a group of aqueous-looking globules, of different sizes, among which there is not a trace of the original structure to be seen. Were this change confined to those calcareous spicules which I have mounted in Canada balsam, I should have inferred that it was caused by the balsam; but I find that the same change accompanies these spicules where they may have been taken in by the kerataceous sponges to form an axis for their horny fibre; and it is worthy of remark that the spicules of the Echinodermata, which may lie side by side with them, do not appear to be similarly affected. Of what nature the origin of this disorganisation may be I am ignorant; it is a chemical question; but the destruction takes place so rapidly in many instances that I have for some time past ceased to mount any more calcareous spicules, and now preserve a record of them by immediate sketches." (Ann. and Mag. of Nat. History, vol. xii. 1873, p. 457.)

Thus it follows that a removal or an annihilation of the forms of these microscopic calcareous organisms takes place after they have been repeatedly washed in fresh water, dried under a great heat, and covered at the same time with balsam, that is, treated artificially; as well as naturally, when they are mixed up with other microscopic organisms to form the core of the horny fibre of marine sponges; while the same thing takes place with the Foraminifera, as testified by slides, in some of which fragments of *Operculina arabica* mounted upwards of twenty years ago have nearly all passed into dissolution, and others in which the spicules of calcareous sponges which were mounted not more than six years since have disappeared altogether, leaving nothing but a few aqueous-looking globules in their places respectively.

So that this dissolution may arise without the presence of "carbonic acid gas in solution in water;" and as it is common to the calcareous organisms mounted in balsam for the cabinet, as well as in the core of horny fibre in the marine sponges of the "deep-sea," we may fairly assume that the removal of the calcareous forms from the siliceous ones in marine deposits may be due to more causes than that assigned by the author of the letter to which I have alluded.

Moreover, even the siliceous spicules which form the core of the glassy fibre in the vitreous sponges may, with the circumjacent layers of the fibre itself, undergo absorption to such an extent, in the skeleton of these sponges, *after death*, as to leave nothing but a siliceous shell with hollow, continuous tube throughout.

Such are the results of my microscopic observations among these minute organisms, and therefore, in the concluding words of the letter under reference, "I think I am justified in wishing the fact to be placed on record."

Indeed, so common and rapid is the process of destruction or inherent disintegration among the microscopic calcareous organisms which I have mentioned, that I am compelled to the conclusion that it is to this chiefly, and not to "carbonic acid gas in solution in water," that we must look for a satisfactory explanation of the fact that minute calcareous organic forms are comparatively absent among the siliceous ones of marine deposits, both recent and fossilised.

The agency of decay is as difficult to comprehend as the agency of development (why we should die any more than why we should live); hence it becomes unphilosophical to limit the operations of either to any *one* process. All that appears certain in the matter is, that the *three* great attributes of the system, viz., creation, preservation, and destruction, form a cycle in which, to speak figuratively, the words "perpetual change" may be enwreathed. HENRY J. CARTER

Budleigh-Salterton, Dec. 26, 1874

The Constant Currents in the Air and the Sea

THE *Philosophical Magazine* for July, August, and September contains a memoir, continued through the several numbers, by Baron N. Schilling, Captain in the Imperial Russian Navy, on "the Constant Currents of the Air and the Sea." It appears that this memoir was first published in the Russian, afterwards in the German, and finally translated and published in the English language; so that it seems to be regarded as a memoir of considerable importance.

When any new and extraordinary results are obtained in any department of important scientific inquiry, the interests of science require that the basis of these results should be critically examined before they are received; and this is especially so where, as in this case, the results are entirely at variance with those of profound and elaborate researches in the same direction which have preceded. We propose, therefore, to examine briefly only a very few points in the reasoning from which these results have been deduced.

The author states in the commencement that equilibrium is disturbed by the three following causes:—

(*a.*) Alteration of the specific gravity of the water or air.
(*b.*) The rotation of the earth on its axis.
(*c.*) The attraction of the sun and moon.

He accordingly treats the subject under these three general heads. Under the first two he endeavours to show that none of the usual causes to which the currents of the ocean and the atmosphere have been usually referred can have much, if any, effect in producing them, and that they must, therefore, be due to some other cause. This seems to be designed to make way for the introduction into this subject of the new disturbing forces contained above under the last head (*c*). Much might be said with regard to what is stated under the first two heads in disparagement of the forces upon which these currents have been heretofore supposed to depend, but we shall confine ourselves here to a very few steps merely in the reasoning under the last head.

The author sets out under this head by assuming that the equilibrium theory of the tides is applicable to the real case of nature, and with this assumption he endeavours to show that the flood-tide rises higher above the plane of static equilibrium than the ebb-tide sinks below it. Now, it is well known by all who are familiar with tidal theories, that this theory is entirely worthless as a representative of the real tides of the ocean. Here, then, there seems to be a weak place in the very foundation of the whole reasoning, and any results based upon it should be received with much distrust, if even all the following steps in the argument were regarded as valid. In the second place, he attempts to show, by a method which is very unscientific and inconclusive, that the forces of the sun and moon tend to produce a current from the east towards the west in the flood-tide, but the reverse of this in the ebb-tide. This is then followed by another assumption in the following language:—"Since, as we have shown, the flood rises more above the normal level of the sea than the ebb sinks below it, we think we can assume, as an hypothesis, that the force of the flood-current will be greater than that of the ebb-current." From this he infers that the difference in these forces must produce a constant current in the ocean in the torrid zone from east to west, but, for reasons which do not seem clear, the reverse of this toward the poles; and in this way, taking into account the deflections of the continents, he accounts for all the ocean currents without the aid of any of the usual causes assigned. In the case of the atmosphere he thinks that the same reasoning must hold, but admits that in this case the alteration of the specific gravity by heat toward the equator may produce some additional and modifying effects. Saying nothing with regard to the steps in the argument, these results are based upon a confessedly doubtful hypothesis, and therefore should not be received without further proof.

This is not a question to be settled by authority, but after the profound investigations of Laplace and Airy upon the tidal forces and the solution of the tidal problem, from which no constant currents around the earth were obtained, we would scarcely expect that such results would be legitimately obtained in a few pages of verbal reasoning without the aid of mathematics. It is true that more recently a very small effect of that kind has been obtained, tending to produce a westward current in all latitudes, from which, by means of friction, the earth's rotation on its axis is supposed to be slightly changed, but this effect is of an order almost infinitely small in comparison with those under consideration, and not at all contemplated in the author's reasoning, referred to above.

Wm. Ferrel

Washington, D.C., Nov. 7, 1874

Mud Banks on Malabar Coast

The phenomenon of the "mud banks and of tracts of mud suspended in the sea" on certain parts of the Malabar coast, is not, as you suppose (vol. xi. p. 135), unexplained. The late Capt. Mitchell, curator of the Madras Museum, some years ago submitted a quantity of the mud to microscopic examination, and published the results in the *Madras Journal of Literature and Science* (I have not the work at hand, or I would give you volume and page). He found it to consist almost entirely of Diatomaceæ, of which he detected and distinguished sixty-two species. In the paper in the Madras Journal Capt. Mitchell gives a list of the genera and a numerical list of the specific forms.

The causes that have determined this local development of Diatomaceæ remain for investigation. They appear sometimes to shift their place. Thus, a Dutch navigator (Stavorinus, I believe) described two such banks as existing to the south of Cochin in 1777, but these no longer exist.

Richmond, Surrey

Henry F. Blanford

Ring Blackbird

Every morning a brown bird (apparently a female blackbird) feeds at my library window. She has a white spot on the breast, and a large white ring, in the exact position of that on a Barbary dove, not meeting under the chin. Is this an unusual variety? I see no mention of such a peculiarity in any of the books at hand, as Lewin, Bewick, Mudie, &c.

C. M. Ingleby

Valentines, Ilford, Jan. 4

*ON THE MORPHOLOGY OF CRYSTALS**

Professor Maskelyne, in introducing his subject, said that in the assembly-room of the Chemical Society he should have to treat of Crystallography as the Science of Chemical Morphology. To the chemist the crystallisation of a substance is a familiar marvel; so familiar, indeed, that he hardly sufficiently considers its importance in relation to his own science. For the physicist, on the other hand, the instinct with which the molecules of a substance obey the laws of a sublime geometry—sublime because simple and universal—is a theme the contemplation of which has guided him to some of the most subtle and almost metaphysical conceptions that he has formed regarding the constitution of matter, and has afforded him invaluable insight into the working of the laws that control the pulsations of heat and light and other manifestations of force. But, although the morphological relations of the crystal are the external expression of the more subtle physical properties which underlie them, he stated that the purpose of the lectures he was about to deliver would be confined to the consideration only of the former.

Placing a large and very perfect crystal of apophyllite from the Ghâts of India on the table, the lecturer pointed out that certain faces carrying peculiar striations were repeated four times; that again others of a triangular form, planted on the angles of the latter, were repeated eight times, and that these had a lustre of their own; while again a plane of octagonal form was repeated only once on the top and at the bottom of the crystal, and carried a peculiar roughened surface, which was seen to be made up of innumerable small square pyramids in parallel positions. He further showed that by turning the crystal round about an axis perpendicular to the last planes, the relative situations of the planes, as viewed from any point, came always to be the same at any revolution through a quarter of a circle. A group of faces repeated with similar properties was defined as a *form*, the crystal in question thus exhibiting three forms; the repeated faces of each form retaining the same general aspect so long as they were not moved round through an angle greater or less than 90°. Then taking crystals of quartz which presented the same *forms*, he pointed out that faces that corresponded to one another on the different crystals, and even on the same crystal, have very different relative magnitudes; and that, in fact, these magnitudes were controlled by no rigid geometrical law. On the other hand, the angles which measured the inclination of corresponding faces on each other were in every case identical; hence angular inclination, that is to say, the direction in space, not relative position, that is to say, precise mutual distance, in the faces, has to be recognised as a principle fundamental to crystallography. This may be expressed by saying that the angles of a crystal are symmetrically repeated.

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* Some notes of the Lectures delivered at the Chemical Society's rooms in Burlington House, on the Morphology of Crystals, by Prof. N. S. Maskelyne, F.R.S.

The study of crystallography in its aspect as the science of chemical morphology thus resolves itself into the discovery of the laws which regulate the repetition of planes, the directions of which in space, and not their relative magnitudes, result from that geometrical instinct which guides the molecules of every individual substance as they become colligated into the symmetrical structure of a crystal.

The lecturer then went on to point out that the features of a crystal the symmetrical recurrence of which had to be studied were the *faces*, the *edges*, and the *quoins* (or solid angles); and he entered on a general geometrical review of the conditions under which faces in meeting produce an edge, or a quoin, or a series of edges or of quoins; and after showing the mode by which the angular inclination of two faces was measured, he dilated on one in particular among the various modes in which faces might meet, namely, that in which three or more faces intersect with each other in the same line or edge, or in edges parallel to the same line. For the crystallographer such groups of planes possess the highest significance; a group thus presenting parallel edges he denominates a *zone*, and it is clear that the direction of the line to which all the edges that can possibly be formed by the intersections of any and every pair of the planes belonging to the zone is indicated when we know the direction of any one of these edges. A considerable part of the earlier among the ensuing lectures will have to be devoted to the consideration of this subject of zones: and the development of the relations between the planes of a zone, under the restrictions imposed by a simple and beautiful law, will be found to involve fundamental principles regarding the symmetry which controls at once the morphological and the physical properties of the crystal in such a manner that all the systems, the symmetrical forms, and the general character of the optical, thermal, magnetic, electric and mechanical properties of the crystallised substance hang, as it were, suspended from that simple law by a chain, each link of which is a simple deduction from the link in the argument immediately above it.

Then taking a crystal of the mineral barytes, Prof. Maskelyne pointed out that certain planes upon it were repeated, some in parallel pairs, and others four times, but also in pairs that were parallel, while all of these planes presented the property already stated to be characteristic of a zone: their edges were parallel. Then, supposing a lapidary's wheel to have been passed through the middle of the crystal perpendicularly to all these edges, and therefore perpendicularly to the faces themselves, he proceeded to deal with the profile of the planes of the zone as they would be seen in such a section. He first defined such a section as the *plane of the zone*, or the *zone-plane;* and characterised it as a plane perpendicular to the edges of the zone. Then drawing a figure to represent this profile or *zone-plane*, he pointed out that two of the planes of the zone being perpendicular to each other, he might draw two lines through a point within the crystal and in the zone-plane parallel to the traces of those two planes, and therefore perpendicular to each other, and that now he could use these lines as axes, or as an artificial scaffolding, to which he could refer the traces of the other faces of the zone, and by the aid of which he might determine the relative directions of those faces.

The circumstance already established by the scrutiny of many crystals, namely, that the faces of the crystal might be drawn nearer or further from a point within the crystal indifferently, justified the lecturer in drawing the traces of two of the faces in the zone so as to intersect in the same point on one of the two axes thus chosen. They would thus intercept on the other axis two different portions of that axis. Calling the former of these axes Z and the latter X, we may say that the ratio of the *intercept* by either of the two planes on the Z axis to the *intercept* on the X axis by the same plane is the tangent of the angle formed by the trace of the plane in question with that of the plane parallel to the axis of X, or the cotangent of the angle it forms with the trace of the plane parallel to the axis Z. This tangent for the plane in question, which gave an angle of 51° 8′ by measurement for the angle on the axis X, had a value 1·2407. The other face of the zone, being represented by the line which met the axis of X at an angle of 68° 4′, would thus yield a corresponding tangent of 2·4834. It will be seen, therefore, that the ratios of the intercepts for the two planes would be, for the first plane,

the X intercept : the Z intercept :: 1 : 1·2407

for the second plane,

the X intercept : the Z intercept :: 1 : 2·4834

If the first of these ratios be called that of $a : c$, the second will be that of $a : 2c$, i.e. of $\frac{a}{2} : \frac{c}{1}$. The co-tangents of the angles would of course yield similar ratios for the distances on the axes X and Z at which the two planes intersect with them: but the common intercept on the Z axis would in this case be unity. The ratios would be

$$\frac{X \text{ intercept}}{Z \text{ intercept}} \text{ for the first plane } = \frac{0{\cdot}80594}{1} = \frac{a}{c}$$

$$\text{Ditto} \quad \text{ for the second plane } = \frac{0{\cdot}40267}{1} = \frac{a}{2c}$$

A third plane in the zone treated in the same way would give an angle the tangent of which would lead to a ratio for the intercepts corresponding to $\frac{a}{5} : \frac{c}{2}$, and if the same process were extended to all the planes in the zone, it would be found that all of them would yield, by the simple process of measuring their inclinations and taking the tangents of their angles on the plane represented by the axis X, values that may be represented by the proportion $\frac{a}{h} : \frac{c}{l}$, where a and c are in the ratio above determined, and where h and l always are capable of representation by rational and generally, nay, almost always, by very small whole numbers. This law thus simply enunciated for the faces of a single zone, as referred to two axes parallel to two faces of the zone here taken as perpendicular to each other, will be found, when the faces of the crystal are referred to three axes instead of two, not in the same plane, and also when they are inclined to one another at other angles than right angles, still to control the inclinations of the faces of the crystal, provided only that the axes $X\ Y\ Z$ thus taken be lines of crystallographic significance, such as lines parallel to edges formed by faces of the crystal; while the ratios $a : b : c$ represent the intercepts on those axes taken in the order $X\ Y\ Z$ of a fourth face of the crystal and are the numerators, while letters such as $h\ k\ l$ stand for the numerical denominators in the fractions that represent the ratios of the intercepts of any other fifth plane of the crystal. Any three numbers in the ratios $a : b : c$ represent the intercepts on the axes of the fourth or standard plane, and are called the *parameters* of the crystal; one parameter in particular being generally taken as unity. The numbers by which the parameters have to be divided in order to assign the ratios of the intercepts to any fifth plane of the system, namely, the simplest numbers expressive of the ratios $h : k : l$, are called the *indices* of that plane; and when these indices are united into what is termed the *symbol* of the plane, by being written in brackets as $(h\ k\ l)$, (3 2 1), &c., one understands by this that

$\frac{a}{h} : \frac{b}{k} : \frac{c}{l}$ represent the ratios of the intercepts of the plane ($h\,k\,l$), and $\frac{a}{3} : \frac{b}{2} : \frac{c}{1}$ those of the plane (3 2 1). Where either of these values h, k, or l becomes zero, this would represent an intercept indefinitely great upon the axis to which it refers, since the algebraic value of a quantity of the form $\frac{m}{0}$ is infinity. Referring again to the original zone on the crystal of barytes, we see that the face, the trace of which on the zone plane was taken for the axis of Z, will nowhere intersect with that axis, so that its index for the axis of Z becomes 0, and similarly for the plane parallel to the axis X. In like manner if an axis Y perpendicular to the zone plane representing the profile of the zone of barytes had been taken for a second axis, all the planes of that barytes zone would have been parallel to that axis Y, which is in fact its *zone axis*, being parallel to the edges of the zone, and the index with respect to that axis would for each plane of the zone have been 0. Thus, taking our indices in the order corresponding to that of the axes $X\,Y\,Z$, we can now say that the plane, the trace of which gave us our axis of Z, would have for its symbol (n 0 0), where n was any whole number, or rather, since we may divide the whole symbol by n without altering the ratio, (100). So, the plane the trace of which gave us the direction for the axis of X would be (001); the standard plane that gave the parameters a and c, having for its intercepts the values $\frac{a}{1} : \frac{c}{1}$, would be represented by the symbol (101), while the other two planes would receive the symbols (201) and (502).

Since all planes on a crystal must intersect if continued far enough with all three or with only two, or finally with only one of the axes, they may be considered as falling into one or other of three groups: such, namely, as have three whole numbers in their symbol; such as have one zero in their symbol (the zero corresponding to the axis with which they do not intersect); and such, thirdly, as have two zeros with unity for their indices.

Passing from a system with rectangular axes, the lecturer next considered the general case of an axial system in which the axes might be oblique to each other. In pointing out that the three planes which contain these axes, namely, the planes $X\,Y$, $Y\,Z$, $Z\,X$, divided the space around the point in which they and the axes intersected into eight divisions or octants, he proceeded to designate the position of a point situate anywhere in space by the Cartesian method of co-ordinates. The point O of intersection of the axes being called the origin, and positions to the right, above, or in front of it, being considered as positive; those to the left, to the rear, and below it, as negative, it becomes possible, by means of lines parallel to the axes projected from the point, to determine its position in either octant. Then taking two planes in a zone which intersected with all three of the axes, such as two planes (111) and (321), the lecturer showed, by a representation in a model, how the edge in which these two planes intersected could have its direction determined by making it parallel to the diagonal of a parallelepiped the sides of which would represent the co-ordinates of any point in that line, in the ratios of $u\,a : v\,b : w\,c$, where u, v, and w represented values which the lecturer proceeded to educe from the symbols of the faces. For this purpose he represented the planes by two equations or expressions involving the ratios of the co-ordinates of any point in the plane, in terms of the parameters of the crystals and the indices of the planes.

Then, by a familiar algebraic method, he obtained an expression for the relations between the co-ordinates for any point in the line in which the planes intersected. The expression thus obtained gave a symbol for the edge in the form of the *determinant* of the indices of the two planes: thus a symbol [U V W], included in square braces, representing the edge formed by the planes ($e\,f\,g$) and ($h\,k\,l$), had for the values of its indices—

$$\mathrm{U} = f\,l - g\,k$$
$$\mathrm{V} = g\,h - e\,l$$
$$\mathrm{W} = e\,k - f\,h$$

and the lecturer proceeded to show that any third plane with the indices $p\,q\,r$ belonging to the zone [U V W] must fulfil the condition—

$$p\,\mathrm{U} + q\,\mathrm{V} + r\,\mathrm{W} = 0$$

and furthermore, that if two zones had a plane in common, the symbol of that plane is found by taking the determinant of the symbols of the zones.

The next subject treated of had reference to the various means which geometry offers for a more convenient treatment and representation of the different zones of a crystal, than that of making an elaborate drawing of its edges. Of these, the method of referring the planes of a system to a sphere by means of their normals was shown to possess great simplicity. A sphere being conceived as described around the point, or *origin*, in which the axes cross one another as a centre, lines drawn from that point perpendicular to each plane of the crystal—the *normals* to these planes—are continued till they penetrate the surface of the sphere in points that will be called the *poles* of the planes, the symbol for a pole being identical with that for the plane to which it belongs. The poles of a zone of planes will thus be distributed along the arc of a great circle of the sphere, its *zone circle*. Hence the discussion of the inclinations of the planes of a crystal, and so, many of the chief problems of crystallography, becomes reduced to their treatment by spherical trigonometry; and what has further rendered this mode of considering the relations of the planes of a crystal especially advantageous has been the means which the principles of the projection of the sphere afford us of graphically representing within the circumference of a circle the poles corresponding to all the faces, however numerous, that any single crystal or that all the different crystals of a substance may present, while the symmetry which they obey in their distribution is seen at a glance. The stereographic projection employed in Prof. Miller's system for this purpose affords by its simplicity, its ready application, and the important geometrical principles which it possesses, by far the most practical, and with a little experience in the student, much the most intelligible representation of even the most complex forms of crystallography.

The characteristics of the stereographic projection were exhibited in a small working model, in which it was shown that the eye, supposed to be placed at a point on the sphere of projection, would see the arcs of circles on the opposite hemisphere as though projected on a plane screen passing through the centre of the sphere and intersecting with its surface in a great circle, *the circle of projection*, at the pole of which the eye was situate; such arcs of circles on the sphere were shown to be projected as arcs that themselves were circular, and the method of finding the centres for these projected arcs, and again the mode of determining the value of an arc on the projected circle by drawing lines from a projected pole of that circle to the circle of projection, so as to intercept the required arc upon the latter circle, were illustrated in the case of arcs upon the model.

The next subject taken up by the lecturer was in the form of a digression in which he treated of the relations of the parts into which a line was divided by four points, two of which might be supposed to be stationary, while the two others assume different positions on the line. First the harmonic and then the anharmonic division of such a line was discussed; and from this, the lecturer passed to the consideration of the harmonic and the anharmonic division of an angle, contained by two and divided by two other lines; and he showed, firstly, that when two lines out of four passing through the same point are perpendicular, and one of these bisects the angle formed by the remaining two lines, the sines of the angles taken in the proper order are in the harmonic ratio. Another point illustrated was that a sheaf of four lines presents the same anharmonic ratios of their sines as does a sheaf of four lines severally perpendicular to them. Reverting to the subject of the traces of the faces of a zone on their own zone plane, it was now seen that we can discuss the subject of relations of any four planes in the zone by considering those of their normals the angles between which are measured on a great circle of the sphere. But it remains to obtain an expression that shall connect these angles with the symbols of the poles or faces of the zone. Such an expression obtained by Prof. Miller in the first case involves a relation of the simplest kind. In short, the anharmonic ratio of four planes is the ratio which we obtain directly from the determinants of the symbols for the four planes. Since, however, the symbols for a zone as obtained from the symbols of different pairs of faces of the zone may, and generally do, differ by a common factor, it is advisable to put the expression for the anharmonic ratios of four tantozonal planes under the form of a convenient symbol given them by V. von Lang, viz., for the four planes $PQRS$:—

$$\left[\frac{PQ}{QR}\right]:\left[\frac{PS}{SR}\right]=\frac{\sin PQ}{\sin(PR-PQ)}:\frac{\sin PS}{\sin(PR-PS)}=\frac{m}{n}$$

where the letters on the left side of the expression stand for the symbols of the planes of which the determinants are to be taken. This very important expression offers the means of determining one unknown symbol or one unknown angle among those belonging to the four planes; another result that flows from it is the necessity for the anharmonic ratios of four planes in the zone, *i.e.* the magnitudes m and n, being always rational if the planes belong to a crystal. And this is another and more general way of stating the fundamental crystallographic law, that of the rationality of indices.

Prof. Maskelyne next proceeded to discuss some of the further results deducible from this great law. Firstly, since the harmonic ratio of four planes brings those planes under the requisite condition of rationality, we can say of any zone in which two of the planes are perpendicular to each other, that for any third plane of the zone inclined on one of them at an angle ϕ, a fourth plane may also exist as a possible plane of the zone, also inclined on the first plane at the angle ϕ; and further, the professor went on to state that if we ask the question what are the conditions for three consecutive planes in a crystal zone to include the same angle ϕ, we find for answer that only in those cases is this possible where cos. ϕ is rational, and that this is only so where ϕ possesses one of the values 90°, 60°, 45°, and 30°.

After a review of the results thus far obtained, the professor entered upon the subject of symmetry, and defining the different varieties of geometrical symmetry; such as, firstly, the symmetry of a plane figure to a centre of symmetry, to one or to several lines of symmetry, or to a pivot of symmetry; and secondly, that of a solid figure to a centre of symmetry, to one or to several planes of symmetry, and to one or to several axes of symmetry: he defined certain terms which would be found useful in the discussion of the symmetry of crystals. Thus, a plane figure was *enthy-symmetrically* divided by a single line of symmetry or *ortho-symmetrically* divided by two lines of symmetry perpendicular to each other; while an axis of, for instance, hexagonal symmetry became one of di-hexagonal symmetry, where each repeated element of form is itself doubled, as by reflection, on a plane of symmetry.

In applying the principles of geometrical symmetry to crystals, it was shown that the best and simplest method was that of dealing with the distribution of their poles on the sphere of projection.

The condition requisite for a single plane of symmetry to exist upon a crystal was then shown to be that this plane should be at once a zone plane and a possible face of the crystal. On the other hand, for a crystal to be symmetrical to a centre, no particular condition was requisite, since the direction and not the requisite position of a crystal plane has been seen to be the important point regarding it, while again every plane passing through the origin may be represented by the symbol of either of its poles indifferently. Now, an axial system as previously defined involves five variable quantities; namely, the three angles between the axes:

ξ, the angle YZ
η, the angle ZX
ζ, the angle XY

and the two ratios involved in the parameters, namely, $\frac{a}{b}$ and $\frac{c}{b}$.

Hence, for a crystal to be centro-symmetrical, all these five quantities may vary from one substance to another. If, however, the crystal system be divided symmetrically by a plane, two of these axial elements are absorbed in satisfying the two requisite conditions of that plane being at once a crystal face and a zone-plane.

A crystal system that is simply centro-symmetrical presents the kind of symmetry characteristic of what is called the Anorthic system of crystallography; a crystal that obeys the principle of symmetry to a single plane belongs to the Oblique or Clinorhombic system.

(*To be continued.*)

TWO REMARKABLE STONE IMPLEMENTS FROM THE UNITED STATES

THE similarity of stone implements, both modern and prehistoric, that obtains throughout the world, has been commented upon so frequently as scarcely to need further illustration. Within a few days, however, I have found two forms of arrow and javelin points that are so unusual in their shapes, and otherwise of interest, that I believe drawings of the two, and a brief note concerning them, will be welcomed by archæologists.

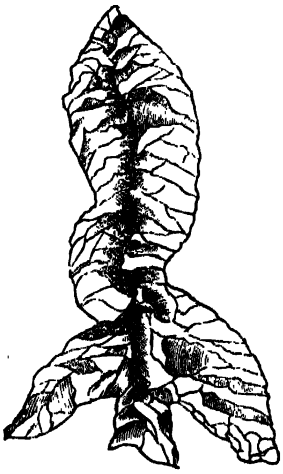

FIG. 1.—(Natural size.)

Fig. 1 represents a "flame-shaped" arrow-point, as this shape has been well called by Mr. E. B. Tylor (*vide* "Anahuac," by E. B. Tylor, p. 96, Fig. 1). Although I have collected fully ten thousand specimens of "Indian relics" from the immediate neighbourhood of Trenton, New Jersey, U.S.A., of which a very large proportion were spear and arrow heads, I have not been able before to duplicate this form, or to find any unmistakable trace of it in the bushels of fragments that here cover the ground in some places. This arrow-head, accompanied by the javelin (Fig. 2) and several of the leaf-shaped pattern, was found in a fresh-water shell-heap on the bank of Watson's Creek, Mercer Co., N. J. The peculiar interest attaching to this "flame-shaped" specimen is, I consider, two-fold. First, the form is one hitherto known only as Mexican—at least, in the works on Stone Implements of which I have knowledge there is no illustration of a similar specimen; and secondly, while possibly this specimen may have been brought from Mexico, through the system of barter so extensively carried on by the aborigines—(I have found fragments of obsidian arrow-points in New Jersey, the material of which, if not the finished weapons, must have come from Mexico)—it seems more probable that it was fashioned in this neighbourhood, and being found, it may be, of an undesirable shape (Mr. Tylor does not state if this pattern was common or rare in Mexico), was not adopted as one of the many forms given to this class of weapons. If my supposition is correct, then the specimen is a good example of the production of a similar style of weapons in distant quarters of the globe.

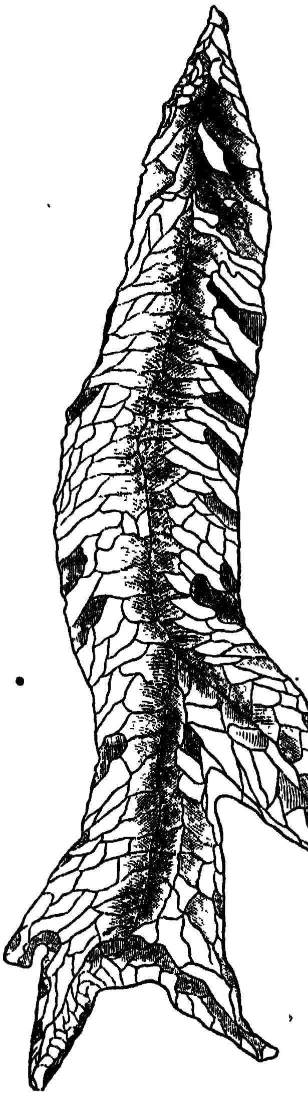

FIG. 2.—(Natural size.)

The mineral, both of this specimen and that which is represented by Fig. 2, is a dull bluish-white hornstone, very similar in general appearance to the European flint. The smaller specimen measures two and a quarter inches in length. It is noticeably thin, and remarkable for the small size and irregular outlines of the flakes. This irregular flaking off of the mineral under the blows of the hammer-stones is due to the "impure" character of the mineral, there being thread-like veins of brittle silex (?) enclosing minute pebbles extending through the mass in every direction, and these appear to have checked the flakes and caused their jagged irregular outlines.

Fig. 2 represents a remarkable javelin head made of the same material as the preceding, and having, but in a less degree, the "flame-shape" of the smaller specimen. The character of the workmanship indicates, I think, that the same aborigine chipped them both. Like the other, this spear-head is very thin and "irregularly" flaked. In the shell-heap in which these were found, as far as we have examined it, there was nothing else that differed from the ordinary "finds" and contents of aboriginal graves, being simply leaf-shaped arrow-heads, grooved stone axes, a corn-crusher and basin ("Querns," *vide* Evans' "Stone Implements of G. B.," p. 233), and a polished celt.

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PROTECTION FOR INVENTIONS

WE stated in our leading article of the 24th ult. on this subject, that in the course of the discussion at the Society of Arts, Col. Strange had mentioned that the Patent Commissioners requested the Royal Society some time ago to nominate one of three eminent men of science who should perform the herculean task of infusing scientific order into the Patent Office, but without salary.

The Society of Arts, in their journal of the 25th ult., have very properly published correspondence which fully establishes the correctness of a statement which otherwise might well be thought incredible. The subject of niggardliness to scientific men is so important, not merely to the men themselves, but more still to the progress of knowledge, and therefore to the interests of the whole community, that we feel bound to republish this correspondence. We must, of course, regret to animadvert on the acts of the late Lord Romilly, who is no longer amongst us to justify them; but the public duty must still be performed, and as his lordship wrote as the spokesman of his colleagues, they can at any rate defend, if they can, what at present seems indefensible.

In Lord Romilly's letter the proposed duties of these unpaid men of science are enumerated: they are to "superintend the general management of the Patent Office, to see that the indexes and abstracts of the specifications are made accurate and complete, and to redress the other defects complained of."

We here see precisely what sort of work four highly salaried lawyers considered men as eminent in science as they in law might with perfect justice be expected to execute for nothing, namely, a combination of hard routine drudgery with the most delicate discrimination in questions extending over the whole range of scientific knowledge. It is true that their labours were to be lightened by the invaluable privilege of "acting in conjunction with the Lord Chancellor and the Master of the Rolls, and of referring to them" whenever the occasion of too tough a problem might require it. In plain English, the men of science were to do all the work of the Patent Office gratuitously, but in the name of these highly-paid lawyers, who notoriously do none of it, but who would thus pocket both the credit and the substantial reward.

If this had been an isolated example of the assessment of scientific work in England, we should hardly have cared to draw attention to it for the mere sake of denouncing exceptional narrowness of view and selfish injustice. It is because the example is typical that we assist Col. Strange and the Society of Arts in exposing it. The best proof of the prevalence of the same spirit is afforded us by some evidence volunteered by the Marquis of Salisbury before the Duke of Devonshire's Science Commission. His lordship observed that "Government departments have got an idea into their heads—I do not know why—that scientific opinions differ in this from medical and legal opinions, that they have a right to have them gratuitously. I have never been able to understand on what grounds that theory rests; and my belief is, that if you would assimilate scientific knowledge to medical and legal knowledge in that respect, you could always get, for a proper remuneration, the very best scientific opinion that the country is able to furnish. You cannot expect that you should be able to make upon a man, every moment of whose time is occupied, a demand involving his time for hours or days of research, if you are not prepared to behave to him as you would to a lawyer in a similar case."

There is no reason to suppose that, though these observations reflect with severity upon the Patent Commissioners' proposal, Lord Salisbury had that case in view when he made them. He was no doubt giving the result of his wide experience as a statesman and departmental chief, and it is a comfort to know that in the present Cabinet there is at least one man competent to assign its true value to scientific work, and bold enough to insist that that value shall be given. It will be perceived that Lord Salisbury hints that the departments are not, and cannot be expected to be, supplied with "the best scientific opinion," because it is not properly paid for. He therefore urges liberality to men of science, as we have always done, strictly on the ground of public policy. An instance in point recently came to our knowledge where a department asked one of our most eminent physicists for an opinion on a meteorological question, but the correspondence was abruptly closed on his venturing to inquire what would be his remuneration for preparing a laborious and difficult report.

Foreign nations are now teaching us that it is time short-sighted parsimony like this came to an end, and that the sooner men in authority are "prepared," as the Patent Commissioners phrase it, to pay handsomely for the most fruitful work of which man is capable, the better for the country.

It must not be overlooked that at the time this preposterous proposal was made by the Patent Commissioners two of their own number were the recipients of 5,000*l.* or 6,000*l.* a year, paid out of the Patent fees, for which they rendered, and could render, for want of the requisite knowledge, absolutely no service to the Patent system, and that the surplus income of the office was about 90,000*l.* per annum.

The following is a copy of the correspondence referred to by Col. Strange in his remarks during the discussion, as having taken place on the subject of appointing unpaid Commissioners of Patents:—

(*Copy of the Memorial.*)

To the Right Hon. the Lord Romilly, Master of the Rolls.

My Lord,—The great use of patents is to make known the inventions, processes, and secrets of others. It is therefore highly important that the mass of information accumulated at the Patent Office should be made available, so as to make known as far as possible all inventions and modes of manufacture for the benefit of the country. The advantage of so doing would be immense, and would help to keep the manufactures of this country in advance of others. Action in this direction on the part of the authorities has been prayed for in every memorial that has been presented.

One of the first memorials was presented by the Institution of Mechanical Engineers, with Mr. Robert Stephenson as president at its head. This was presented in 1853 to the Right Honourable Frederick Lord Chelmsford, Lord High Chancellor of Great Britain, the Right Honourable Sir John Romilly, Master of the Rolls, Sir Fitzroy Kelly, her Majesty's Attorney-General, and Sir Hugh McCalmont Cairns, her Majesty's Solicitor-General; and prayed for greater facilities being given to persons making inquiries in any branch of knowledge at the Patent Office.

The second memorial in 1862 was presented to the Right Honourable Sir John Romilly. It prayed amongst other things for "a building as an office for patents, including in it a complete library, a commodious reading-room, and suitable offices for a proper staff of clerks and others to prepare well-digested and numerous abstracts and abridgments of inventions and processes, made public either by the specifications of patents or otherwise, and whether English or foreign."

A third memorial was presented to Sir John Romilly in 1864. It prayed not only that the efficiency of the office should be increased, but called the attention of the Commissioners to recent reductions in the staff and its disorganised state; which staff was "utterly inadequate to satisfy the requirements of persons seeking information among the very numerous works contained there." The memorialists went on to state that "they had entertained the hope that, so far from a reduction being made, there would have been an increase ordered to such an extent as would have enabled the abridgments of the specifications in the various branches of art (which abridgments were commenced about seven years ago) to be pushed vigorously forward, so as to complete the abstracting of the whole of the original specifications, and to keep up those abstracts from year to year as new matter is furnished. Your memorialists feel it is hardly possible to overrate the advantages to be derived by the public from a complete and intelligent system of abstracts; and they venture to urge upon the consideration of the Commissioners the necessity of at once providing a sufficient number of qualified persons (to be under the entire control of the scientific officer appointed by the Commissioners to superintend the specifications) to assist that officer in preparing such abstracts, and also to collect and epitomise scientific information generally."

The president and members of the Institution of Mechanical Engineers addressed a memorial in 1864 to the Right Honourable Lord Westbury, then Lord Chancellor, bringing under his lordship's notice the fact "that very great loss and delay are occasioned to manufacturers, inventors, and others, by the want of a complete classification and the prompt indexing of all inventions, whether patented or not, foreign as well as English. Such a systematic arrangement as is needed is quite within the compass of an efficient staff of officers possessed of technical knowledge, and could be at once proceeded with; the state of inventions could then be ascertained, and the common case of several persons patenting the same thing would be avoided."

In 1864 a Select Committee of the House of Commons inquired at great length into the working of the Patent Office; and reported, in accordance with the general tenor of the evidence, that much more was required to be done at the Patent Office to render it efficient; that more attendants were required, and "that the want of increased accommodation was so much felt as to prejudice the due administration of the Patent-law" (paragraphs 3 and 4 of report; answers 10 to 13, 18 to 21, 658 to 662, 667, 817, 863, 1038, and 1039 of evidence).

We merely allude to the opinions expressed by the Select Committee of the House of Commons, scientific men, manufacturers, engineers, and inventors, as the various memorials and other documents are in the possession of the Commissioners of Patents; but we would further mention that the various Commissioners of Patents have from the year 1858 reported from time to time to the Lords of the Treasury that great improvements were wanted, and a good building urgently required for the purposes of the Patent Office.

In conclusion we beg to state that it is our decided opinion, and that of many of those who have signed various memorials, that it would conduce greatly to the progress of manufactures and the advancement of commerce, if the large stock of knowledge of inventions and processes, both patented and open, stored at the Patent Office, were made available to the manufacturers and the public generally; and this your petitioners believe would best be compassed if her Majesty were graciously pleased to appoint that "other person as Commissioner of Patents," as contemplated by the Patent-law Amendment Act of 1852, and if the staff at the Patent Office were augmented by the addition of a sufficient number of persons, possessed of good technical knowledge, and well able to abstract all specifications as they came in daily, so that they might at once be entered into an efficient Subject-matter Index, which would give a true indication of what was in the specifications. In addition to this of course the large number of specifications already at the office would require to be abstracted and entered in a similar manner in a new edition of subject-matter indexes, that would really indicate what was contained in each specification, which the present indexes do not. Further, we beg to urge that similar subject-matter indexes be formed of all inventions and processes comprised in the very numerous indexes and tables of contents of the scientific books contained in the excellent scientific and technical library of the Patent Office, so that any person using due diligence might easily learn with tolerable certainty whether an invention were new or old, which is not now the case.

We beg to append a sample page of such two subject-matter indexes as we would submit are urgently required. It is almost superfluous to mention that there are now several hundred thousands of pounds accumulated surplus, and an annual surplus of about sixty thousand pounds, contributed by the very class of persons who would benefit by such improved indexes.

L. L. Dillwyn, M.P.
Richard Baggallay, M.P.
Charles Fox, Mem. Inst. C.E.
Charles Hutton Gregory, President Inst. C.E.
Edward Woods, Mem. Inst. C.E.
C. William Siemens, Mem. Inst. C.E., F.R.S.
Robert Mallet, Mem. Inst. C.E., F.R.S.
Frederick J. Bramwell, Mem. Inst. C.E. Council.
Edward A. Cowper, Mem. Inst. C.E.
20th March, 1868.

(*Copy of Reply of the Master of the Rolls to Mr. Dillwyn.*)

Rolls, 31st March, 1868.

Sir,—I transmitted to the Lord Chancellor the memorial presented to me on the 20th March instant by yourself and the gentlemen who accompanied you, relative to the present state of the Patent Office, together with my views on the subject; and we have since considered the matter in consultation together.

The result of this is that we are prepared to recommend to her Majesty's Government that three gentlemen should be appointed to act as Commissioners of Patents together with the Lord Chancellor and the Master of the Rolls for the time being—one to represent mechanical science, another to represent chemical science, and a third to represent the subjects more usually and more especially comprised in the term "Natural Philosophy." We should propose that the gentlemen to be recommended to her Majesty for this purpose should be, as regards the first, from gentlemen to be nominated by the Society of Mechanical Engineers; as regards the second, from gentlemen to be nominated by the Chemical Society; and as regards the third, from gentlemen to be nominated by the Council of the Royal Society. But we are not prepared to recommend that any salary should be attached to the services of these gentlemen. We trust and believe that gentlemen fully competent for the purpose may be found who have sufficient leisure, and who, from their love of science and their desire to disseminate more widely the discoveries made in these branches of science, would be willing to give their services without remuneration, and to superintend the general management of the Patent Office, to see that the indexes and abstracts of the specifications are made accurate and complete, and to redress the other defects complained of in your memorial, acting in all these respects in conjunction with the Lord Chancellor and the Master of the Rolls, to whom they would refer whenever the occasion might require it.

I think it, however, desirable to repeat that, on fully considering the subject, both the Lord Chancellor and myself have arrived at the same conclusion, that it would be inexpedient to create either one or more salaried officers for this purpose; and to say that we should both, if applied to, recommend her Majesty's Government not to accede to that part of the views of the gentlemen who composed the deputation, which had relation to the creation of paid officers. Romilly.

L. L. Dillwyn, Esq., M.P.

FRANCIS KIERNAN, F.R.S.

We have to record the death, on Dec. 31st last, of Mr. Francis Kiernan, whose discoveries in connection with the structure of and circulation through the liver, published in the Philosophical Transactions of the Royal Society, and separately in a work entitled "Anatomical Researches on the Structure of the Liver," are so well known to all physiologists and histologists.

Mr. Kiernan was born in Ireland on October 2nd, 1800. His father was a member of the medical profession, who came to this country during his son's younger days. The son was educated at the Roman Catholic College at Ware, in Hertfordshire, and received his medical training at St. Bartholomew's Hospital, where, as a student, he gave signs of marked ability, devoting all his energies to the study of anatomy. In 1825 he obtained the membership of the College of Surgeons, and the Fellowship in 1843. In 1834 he was elected a Fellow of the Royal Society, subsequently receiving the Copley Medal·

Mr. Kiernan was amongst those most actively engaged in the establishment of the University of London, of the Senate of which institution, on its incorporation in 1837, he became a member, and subsequently a frequent examiner in his special subjects. He was never married. In 1865 he was seized with a paralytic stroke, from the effects of which he never fully recovered.

The investigations of Mr. Kiernan on the liver, together with those of Mr. Bowman on the kidney, will be always looked back to by biologists as the first-fruits of the introduction to natural science of the microscope in its modern form. Unlike many such productions, however, they have both fully stood the test of time.

THE RECENT THAW

The thaw of January 1, 1875, happened almost simultaneously in Paris and London, and the phenomenon having been observed in both cities, it is possible to come to a definite conclusion concerning many similar occurrences.

The exact hour of the change in Paris may be stated to have been nine o'clock in the evening. If we suppose it was four o'clock in London, we see that five hours were a sufficient space of time for the gale to run the distance between both cities—about 300 miles.

Telegraphic warnings had been sent from London to the Paris Observatory, but were of little practical use, for want of proper means to disseminate the intelligence: otherwise, many inconveniences which were experienced by the Parisians, surprised by the falling of sleety snow, would have been avoided.

This remarkable occurrence may be referred to as affording strong evidence in favour of extending and popularising in both countries the use of weather telegrams. But I think it may be useful to try to draw from these circumstances some other conclusions.

In January 1871 I inquired of M. Buys Ballot, now the president of the Utrecht Meteorological Office, if he could tell me how to foresee if winds were likely to take a favourable course for ballooning from Lille to besieged Paris. I was told by the learned meteorologist to look at the upper clouds, as any real change must of necessity take place in the upper strata of the atmosphere, and descend gradually to the earth.

Unfortunately these upper clouds were for days and days running from the south, and the opportunity of trying an ascent was lost. Before the sudden thaw of the 24th of December, as well as before the 1st of January, I saw other clouds taking distinctly the same northern course. It seemed to me that the motion of the upper strata was communicated gradually to the air in closer proximity to the earth, and that the meteorological revolution of the 1st of January was preceded by a great change produced in higher regions through some unknown cause.

My conclusion seems to me to be supported by the fact that the air was obscured by vapours before the thaw actually took place. The sun lost apparently almost all his warming power, as the difference between *minima* and *maxima* read at the Observatory of Paris at the end of the cold periods amounted to a very few centesimal degrees—three or four only; clear air and hot sun being, if the theory is supported by facts, an evidence that cold weather is to last for a long period. It seems that the upper current is produced by cold and dry air coming from the north and pushed southwards.

It would be interesting to submit the theory to the test of systematic ascents, in order to inquire into the condition of the upper winds, and to measure their deflection or velocity, or their dimensions either in vertical or in horizontal directions.

Some of the readers of NATURE may possibly feel inclined to help me in working out these suggestions practically, or at least to ascertain if they are justified by facts as far as can be ascertained without travelling in the air.

W. DE FONVIELLE

EARTHQUAKES IN THE PHILIPPINE ISLANDS

A CORRESPONDENCE from Manila, dated Oct. 17-18, gives the following notice of earthquakes occurring there and in the neighbourhood on Oct. 16, which may be of interest to some readers of NATURE :—

Manila.

10.12 A.M.—Hard shock; duration about 1 min.; general direction from E.—W., but moving from S.E.—N.W. to N.E.—S.W.

10.15 A.M.—E. 25° N.—W. 25° S.; duration 5 sec.; rotation from E.—N.

10.20 A.M. till 10.15 P.M.—Thirty-seven other light shocks, *i.e.* in the whole thirty-nine shocks in twelve hours.

The interval of these shocks became at last greater and greater in the following order :—

10.20 A.M.
10.25 „
10.30 „
10.40 „
10.43 „
10.46 „
10.50 „
10.51 „
11.12 „
11.15 „
11.20 A.M.
11.23 „
11.26 „
11.31 „
11.34 „
11.41 „
11.44 „
11.46 „
11.58 „
12.2 P.M.
12.19 „
12.20 „
12.22 „
12.24 „
12.31 „
12.42 „
12.45 „
12.50 „
12.55 P.M.
1.9 „
1.52 „
2.40 „
4.2 „
6.25 „
8.15 „
9.15 „
10.15 „

Bulacan.

10.8 A.M.—Hard shock.

10.11 A.M. till 1 P.M.—Lighter shocks.

Pampanga.

10.13 A.M.—N.W.—S.E. Hard shock; duration 50 sec.

10.21 A.M.—Duration 20 sec.

12.30 P.M.—Light shock.

Pangasinan.

10.25 A.M.—S.E.—N.W. Duration 26 sec; light shock.

Cavite.

10.11 A.M.—Light shock.

10.45 A.M.—Light shock.

12.13 P.M.—Light shock.

[*Batangas.*

10.2 A.M.—E.—W. Two shocks, of 10 sec. and 7 sec. duration.

Laguna.

Light shock; 2 sec. duration.

Royal Natural Hist. Museum,
Dresden, Dec. 25

A. B. MEYER

THE TRANSIT OF VENUS

THE following telegrams have been received during the past week :—

From Prof. Peters, *viâ* Wellington, New Zealand :—"Transit observation great success first contact; photographs, 237."

"*New York, Dec.* 31.—Intelligence has been received here from Honolulu, dated the 12th inst., respecting the observations of the Transit of Venus at that station. The atmospheric conditions were favourable for the observations; 150 measures of cusps and limbs and 60 photographs were obtained. A totally unexpected appearance was presented at the internal contact. The disc of the planet became visible as an entire circle some minutes before contact, and from then to the complete establishment no definite or sudden phase was observed. There was no black drop after the internal contact. Twenty out of sixty photographs came out blurred. Valuable results, however, were obtained. The first external contact occurred at 3h. 7m., and the first internal contact at two minutes later than the *British Nautical Almanack* stated. The revelation of the complete circle of the planet occurred before the actual internal contact, owing to the effulgence of the corona, the sun illuminating the whole surface of Venus before the complete immersion."

In connection with the news from Honolulu, an article in the *Times* of Tuesday says :—"The most remarkable part about it is that the observers evidently regarded as an 'unexpected appearance' a phenomenon similar to one observed and recorded in the former transits of 1761 and 1769. In the observations of Chappe d'Auteroche in the latter year, recorded by Cassini, a drawing is actually given of the horns of Venus visible beyond the edge of the sun, and it seems probable from the text that the planet was actually seen on the sun's chromosphere at the moment of egress."

Indeed, this phenomenon need not have caused any surprise if the conditions had been previously clearly understood. In reference to this point, some statements from the *Daily News* Thebes correspondent (Dec. 9) are worth quoting. In speaking of the commencement of the phenomenon the correspondent says Venus "appeared anything but a promising subject for the purpose at first. She seemed literally to dance about the face of the sun, and her limb was jagged like a saw. They both appeared elliptical in an almost extraordinary degree, owing of course to refraction, and they did not lose it entirely till they were at least 7° from the horizon. Gradually the limbs of both got more and more defined, till Venus looked like a small black pea resting on a luminous disc. The sun, however, still remained somewhat troublesome, particularly to the photographers, and it was not till just before internal contact that he was really steady. The atmosphere of Venus was distinctly seen at certain periods. It showed as a pale white circle round part of her edge, and was totally different to the brilliant sunlight. The general remark was that it reminded us of moonlight. This caused a certain difficulty in estimating the true time of contacts, and perhaps any small discrepancy in observation may be accounted for by this phenomenon. . . . There is one curious coincidence to note, and that is, that no one seemed to have observed the black drop which has been so much talked about; a faint haze was seen, and a few jets of black springing out from each side of the point of contact, but nothing more. Neither in the photographs did it show, which perhaps might have been expected. Certainly, the weather could not have been more favourable just at the critical time, though, curiously enough, immediately after, a haze came on, which would seriously have affected the results. Need I say that we are all thankful the observation has passed off so well, and if only the other stations to which expeditions have been sent are equally fortunate, the sun's distance ought to be definitely settled. I fully expect that the appearance of the faint line will give rise to a long discussion in the astronomical world. It will be very curious to note what other stations saw. At all events one thing is certain, and that is that our atmosphere must have been very clear, and also that of Venus; clouds in the planet must have intercepted the sunlight, and have prevented the formation of the luminous ring, or rather partial ring. At one time the whole planet, when it had half passed over the limb of the sun, was visible, reminding one of the dark part of the new moon on a clear night. I may say that the whole appearance of internal contact was quite unexpected, and the absence of the black drop puzzled every observer. External contact was observed, I hear, almost simultaneously by all observers, a point of the utmost importance when the degree of ellipticity of the planet has been determined from measurements of her diameter."

NOTES

THE Germans, we are glad to see, have finally decided to send out a second expedition to the east coast of Greenland. It is to consist of two steam-vessels, of 300 tons burden, each manned by thirty men; one to explore Greenland, while the other advances to the north pole. The estimated cost is about 50,000*l.* sterling, and the expedition is to leave in June 1875 or June 1876, according as the money can be got together. There is no hint that the German Government is to lend assistance, though we hope it will do something, after such a good example has been set by our own Government. It would be a splendid and healthy outlet for national rivalry to have these two expeditions start this year, each doing its best to win the Arctic campaign, and striving to be the first to unfurl its particular national flag over the long-fought-for goal. At all events, during the next two or three years we ought to hear of some fine conquests having been made in the far north. The preparations for our own expedition are steadily progressing. Commander Markham, R.N., arrived on Tuesday at Portsmouth.

ONE of the principal articles in this month's *Geographical Magazine* is on Lieut. Cameron's recent discoveries in the Tanganyika region. The writer justly rates Lieut. Cameron's work as of the highest importance, and we earnestly hope that the appeal of the Royal Geographical Society for subscriptions to enable Cameron to complete his work will be liberally responded to. Already 1,494*l.* have been subscribed, including 500*l.* from the Geographical Society; but of this, 544*l.* will be swallowed up by expenses already incurred, so that there is really only 950*l.* available. This, "it is confidently hoped, will be largely increased as soon as the people of England are fully aware of the necessities of their young countryman in the heart of Africa, and of the glorious work that he is bravely attempting to do, alone and single-handed."

DR. ALLCHIN will give the course of lectures on Comparative Anatomy and Zoology this session at University College, London, pending the appointment of a successor to the late Prof. Grant. The introductory lecture will be delivered to-day, at 4 P.M.

MR. BOWDLER SHARP, of the British Museum, delivered a lecture on "The Birds of our Globe," on Tuesday, January 5, in the private music-room at Mr. N. Holmes's residence, Primrose Hill. The lecturer, commencing with the "Accipitres," or birds of prey, gave a concise description of the various families and genera of birds, terminating, according to modern classification, with the "Struthiones," illustrating at the same time the different groups by an elaborate series of paintings specially prepared for the occasion by Herr Keulemans, the well-known ornithological artist.

WE have received a foretaste of the forthcoming new edition of the "Encyclopædia Britannica," in the shape of a separate reprint of Mr. A. R. Wallace's carefully written article on "Acclimatisation." After an examination of a considerable number of instances, Mr. Wallace concludes: "On the whole, we seem justified in concluding that, under favourable conditions, and with a proper adaptation of means to the end in view, men may become acclimatised with at least as much certainty and rapidity (counting by generations rather than by years) as any of the lower animals."

THE great hurricane which swept over Hong Kong on the 22nd and 23rd of September last, and to which we referred at length last week, appears, from official reports, to have caused considerable damage in the Government Gardens. Mr. Ford, the superintendent, reports that the largest trees suffered the most severely, several of the oldest and largest being entirely destroyed. Many other trees, although not destroyed, were severely damaged, having nearly the whole of their branches broken off, while many which were thus damaged, but which had not their roots broken or strained, will, in course of time, produce fresh branches and foliage. A considerable number of smaller trees and shrubs were entirely destroyed, having been broken off close to the ground, while others were blown over and a great portion of their roots so much exposed to air and light as to threaten their ultimate destruction. Operations were at once commenced for the preservation of as many of the trees and shrubs as there was any prospect of saving, and the greater part of them were replanted and protected by supports. The flower-pots containing plants in various parts of the gardens were broken in great numbers, and the plants for the most part much disfigured. In the nurseries, likewise, the plants in pots were thrown out, but no serious damage was effected. With regard to trees in different parts of the town, which come under the Forest Department of Hong Kong, Mr. Ford says: "I have observed that in nearly all cases where trees were blown down in the typhoon of September 1871, and those trees were again set upright and have continued to grow up to the late typhoon, they have again fallen, and in several cases are this time entirely destroyed; thus proving, as a general rule, that when once a tree suffers so severely as to cause its prostration, little reliance can be placed on that tree ever afterwards continuing or becoming a sound and healthy one." In the Surveyor-General's Report to the Colonial Secretary of Hong Kong on the damage caused by this hurricane, it is regretted that no record remains of the pressure of the wind, owing to the meteorological station connected with the Government Hospital being swept away by its force. It is further said, however: "That the island was not many miles distant from the focus of the cyclone is proved not only by the intensity of the wind, but by a feature known to exist only within such a focus, namely, the abrupt intervals of calm during the height of the gale. These lulls were instantaneous, often lasting as long as four or five minutes; and, alternating with the most violent gusts, equally sudden, the conjoint action of the two became, as it were, that of a battering ram."

MANY experiments have been tried in France to test the effects of cold on railway axles. Many engineers suppose that accidents to wheels do not result from any diminution of tenacity of the metal, but merely from its losing all its elasticity owing to the frost hardening the surface of the earth. A fact which can be adduced as a strong argument in favour of that theory was observed by the inhabitants of Montmartre during the last period of frost. The passing of the trains which run so frequently through the Batignolles [illegible]nnel at a distance of half a mile was heard by them day and night, which is never the case in ordinary circumstances. As soon as the thaw set in the trains ceased to be heard; the earth having resumed its former elasticity, the sounds were dissipated as before. It has been observed by French railway engineers that thaws are apt to lead to the breaking of axles and chains. The elasticity being only partially recovered, many shocks affect the trains when running at a fast rate, and are apt to lead to catastrophes.

MR. W. PHILLIPS, of Shrewsbury, proposes to publish, under the title of "Elvellacei Britannici," dried specimens of the larger ascomycetous fungi. To persons forming collections of our indigenous fungi, Mr. Phillips's fasciculi will be useful, since similar collections have hitherto principally comprised only the *Hymenomycetes*. Mr. Phillips will be assisted by various well-known mycologists, and he proposes to issue a very limited number of copies at twelve shillings each fasciculus of fifty species.

M. Amédée Guillemin has published through Hachette a very interesting work on Comets, profusely illustrated. All the modern theories are discussed, from Descartes to Schiaparelli, a number of traditions and stories connected with comets being also introduced.

We omitted to mention in last week's notice of the anniversary meeting of the French Academy the speech delivered by M. Dumas on De la Rive. It is a part of the duty of the perpetual secretaries to deliver such *éloges* at each anniversary meeting. That duty has been performed by each perpetual secretary from Fontenelle to our days, and the collection of these *éloges* is an important part of the Academical publications. M. Bertrand is at present engaged in preparing the *éloge* of M. Elie de Beaumont, which will be delivered in 1876.

A commission, nominated by the Geographical Society of Paris, and composed of Admiral Fluriot de Langle, MM. Delesse, Charles Grad, H. Farry, and Jules Girard, has just published some instructions to navigators to aid in their study of the physical geography of the sea. These instructions, which the Society sends gratuitously to everyone who is willing to turn to account, in the interest of science, his stay on board ship, point out, in a style sufficiently precise and elementary to come within the comprehension of all, the principal points on which observations should be made, and the best methods to be adopted for collecting useful particulars.

At St. Peter's College, Cambridge, on April 6, there will be an examination for a Natural Science Scholarship. The subjects of examination will be botany, chemistry and chemical physics, geology, and comparative anatomy and physiology. No candidate will be examined in more than two of the above-mentioned subjects. Applications to become candidates must be made on or before March 29 to the Rev. J. Porter, tutor of the College, who will give all necessary information.

By the death of Prof. William Macdonald, of St. Andrew's University, the chair known as that of "Civil and Natural History" becomes vacant. Dr. Macdonald held it for twenty-four years. The post has from the first been practically a sinecure, and almost seems to have been instituted for the sake of the professor. We wonder if the Senate of St. Andrew's will allow their University to be befooled by the appointment of a successor to Dr. Macdonald in this unique chair of "Civil and Natural History."

We are glad to see that it is intended to form a society at Watford, having for its object the investigation of the meteorology, geology, botany, and zoology (including entomology, ornithology, &c.) of the neighbourhood, and the dissemination amongst its members of information on natural history and microscopical science. The evening meetings of the society will be held (by permission) in the rooms of the Watford Public Library, and during the summer months field meetings will also be held. It is proposed that the annual subscription be ten shillings, without entrance fee. The names of ladies and gentlemen willing to join the society will be received by Dr. Brett, Watford House, by Mr. Arthur Cottam, St. John's Road, Watford, and by Mr. John Hopkinson, jun., Holly Bank, Watford. It is hoped that a sufficient number of names will be received within the next few days to warrant a meeting being called to found the society in the course of the present month.

The Institution of Civil Engineers seems to be one of the most prosperous of our scientific societies. On its books on Nov. 30, 1874, were 2,130 members; its income for the past year was upwards of 10,000*l*., and its investments amount to nearly 33,000*l*.

A rare phenomenon, says the *Malta Times*, occurred in the forenoon of Monday, the 21st ult. During a strong wind from the south-west, which had prevailed for two days previously, the sea suddenly rose several feet and flooded the moles and roads surrounding the harbours, causing four or five steamers, moored between the Custom House and Calcara Rise, to snap their stern hawsers like packthreads, and carrying away boats that were hauled ashore in the French and other creeks. The sea then receded as suddenly as it rose, leaving portions of the bottom of the harbour exposed, upon which men and boys might be seen collecting fish and other marine animals that had been left aground by the retiring water. Shortly afterwards the sea resumed its ordinary level. Similar phenomena have been noticed occasionally during the course of many years.

M. W. de Fonvielle has published a small volume, "Le Métre International définitif," giving an account of the determination of the metre and the negotiations relating to it from 1789 to 1874.

The *Daily News* of Monday has a letter from its correspondent on board the *Challenger*, giving a few details in addition to those contained in the recent *Times*' letter. From Hong Kong the ship was to return to Manila and other places, as far as New Guinea, then make for Yokohama, Japan.

There was a slight shock of earthquake at Malta on Friday last, at 1 P.M.

The additions to the Zoological Society's Gardens during the past week include two Razor-billed Curassows (*Mitua tuberosa*) and a Yarrell's Curassow (*Crax carunculata*) from South America, presented by Mrs. A. E. Nash; seven Golden Agoutis (*Dasyprocta aguti*), from Guiana; five Guira Cuckoos (*Guira piririgua*) from Parà; an Ani (*Crotophaga ani*), two Orinoco Geese (*Chenalopex jubata*), two Red-tailed Guans (*Ortalida ruficauda*), a Spotted Cavy (*Cœlogenys paca*), and a Collared Peccary (*Docotyles tajacu*), all from South America, purchased.

THE PRESENT CONDITION OF THE ROYAL SOCIETY*

(*Extracted from the President's Address at the Anniversary Meeting.*)

Committee of Papers.—The strength of the Society being represented by its publications, the Committee of Papers is the one whose functions are unquestionably the highest and most onerous, as they are the most closely scrutinised by the Fellows and the public.

Every member of the Council is included in this committee, which meets after almost every Council meeting, and no part of its duties is at present performed by a sub-committee. It appears to me to be very doubtful whether this arrangement, even if the best, can last, owing to the greatly increased number of papers now communicated and their augmenting bulk, and to the value of their contents being less easily estimated as the subjects of scientific research become more specialised. As it is, in the majority of cases but few of the members present can judge of the merits of many of the papers; and it is not easy after a protracted Council meeting, and one occupied with promiscuous business, to fix the attention of a large committee upon subjects with which but few members present may be familiar. It is true that the committee is aided in all cases by the written opinions of careful and impartial referees, and by the special attainments of our secretaries, and that it is most desirable that the sometimes divergent opinions of these should be weighed by others as well as by experts in the subjects of the papers. But for all this a committee of the whole Council is not necessary; and though I should not be disposed to advocate a return to a system once pursued of resolving the committee into sub-committees charged with special subjects, I think it possible that some other plan may meet the difficulties of the case and relieve our overburdened Council of much labour. A possible plan for relieving both the Council and the committee, while securing as careful a scrutiny of the papers as we now have, would be a division of the labours of the committee, and an addition of extra members to its number, chosen from among the Fellows, who should continue in office throughout the session. This, or some plan of the kind, would have the advantage of engaging more of the Fellows than at present in the affairs of the Society; and I feel sure that so responsible a position as that of Extra member of the Committee of Papers would be accepted with pride by those Fellows who are most competent to discharge the duties.

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* Continued from p. 178.

It seems convenient to refer here to suggestions that have been made to me as to the expediency of breaking up our transactions or proceedings, or both, into sections devoted to physics and biology respectively, or even subdividing them still more. This separation has been advocated on the ground that science has become so specialised that no scientific man can grasp all its subdivisions, that the mixed publications are cumbersome and difficult to consult, and that private libraries are now overburdened with the publications of Societies, of each of which a small part would suffice for all their possessors' wants. There is no question that this, if now an evil, will soon become intolerable, for our publications increase rapidly in number of contributions and in their bulk. There are, however, so many considerations to be discussed before any system of relief can be adopted, that I confine myself to stating the subject as it has been urged upon me.

The Society's library now comprehends 36,270 volumes and 10,000 tracts, the most considerable collection of scientific works in the possession of any private body; and in respect of Transactions and Proceedings of scientific academies, societies, and institutions, I believe it is unrivalled among public bodies.

A complete Catalogue of the Scientific Books, MSS., and Letters, which I regret to say is unaccompanied by any historical or other information regarding the library, was printed in 1839. Another catalogue of the miscellaneous literature and letters was printed in 1841; and there is also a MSS. catalogue of maps, charts, engravings, and drawings, which number upwards of 5,000.

For some years past the Library Committee, indefatigable in steady endeavour, have greatly increased the value and efficiency of our library; and in 1873, previous to leaving old Burlington House for our present apartments, it ordered a rearrangement of the whole, and the preparation of a new catalogue, which is being proceeded with as fast as the current duties of the officers will permit.

In the mean time the Catalogue of Transactions and Journals is printed for working purposes, and will be added to until such time as the general catalogue is ready for press.

The collection of Oriental MSS. presented by Sir William Jones in 1792, and added to by his widow in 1797, was largely consulted by several of the distinguished foreigners who assembled at the Oriental Congress in London last September. From conversation with some of these gentlemen, I learnt that the collection contains many documents of the greatest value and rarity, together with some that are unique; and it may be worth the consideration of the Council, whether they would not be more useful if transferred to, or deposited in, the India Office or some other Oriental library, where they would be consulted to greater advantage than here. At present they occupy part of the room devoted to our archives.

The two most noteworthy additions to the library during the past year have been the MSS. on logic and mathematics of our late fellow Prof. Boole, presented by his widow; and Dr. Fayrer's collection of forty-seven original drawings of the poisonous snakes of India, which are of interest in connection with his and Dr. Brunton's experiments on snake-poisons, printed in our "Proceedings."

The apartments devoted to the library afford space for twenty years' addition at the present rate of increase; they are remarkably commodious; and those who assembled at our Soirée last spring and saw them for the first time lighted up and decorated will consider with me that they are not only a noble suite of apartments, but that they are in keeping with the purposes and the high position of the Society.

You are aware that the Council resolved that the Catalogue of Scientific Papers should be continued through the decade 1864-1873. This work is now progressing under direction of the Library Committee, who have had charge of the undertaking from the commencement. The necessary funds are granted by a vote of the Council, and we may hope, in the course of the coming year, that the seventh volume of this important work will be ready for publication; and we confidently trust that the Government will extend its liberality by printing this as it did the former volumes of the series. The total outlay upon the six volumes already published (which comprise papers published between 1800 and 1863) has been 8,936*l.* 12*s.*, of which 3,720*l.* 15*s.* 6*d.* (the cost of preparation) was defrayed by the Society, and the rest (the cost of printing, paper, and binding) by the Treasury; against which must be set the proceeds of sale, repaid to the Treasury in occasional amounts, the last within the present year, making a total amount of 1,000*l.*

The number of copies of the Society's Transactions distributed gratuitously to institutions and individuals not Fellows of the Society is now 209, and of the Proceedings 325.

House Committee.—The great labours of this committee in connection with the removal into the apartments we now occupy had not terminated at the beginning of the past session; and various matters have still to be attended to. That the arrangements the committee has made have given satisfaction to the Fellows at large has been amply acknowledged. We are, indeed, greatly indebted to them for the knowledge, experience, and time, all so freely given in our service, as also to the knowledge of our requirements and the practical views of our Assistant Secretary, upon whom fell the duty of suggesting the best disposition of the apartments throughout this large and commodious building. Lastly, I would beg your permission to record the services of the eminent architect, Mr. Barry, who has throughout shown the greatest regard to our position and requirements, and but for whose professional ability enlisted in our service we might have found ourselves as ill as we are now well accommodated.

Funds and Bequests.—The Donation Fund.—In 1828 our former President, Dr. Wollaston, invested 2,000*l.* in the Three per Cents for the creation of a fund, the dividends from which were to be expended liberally "from time to time in promoting experimental researches, or in rewarding those by whom such researches have been made, or in such other manner as shall appear to the President and Council for the time being most conducive to the interests of the Society in particular, or of science in general." There is no restriction as regards nationality: but members of Council are excluded from participation during their term of office.

To this fund many liberal additions were made. Mr. Davies Gilbert gave 1,000*l.*; Warburton, Hatchett, Guillemard, and Chantrey each contributed 100 guineas. From these gifts, and by accumulations, the fund in 1849 had increased to 5,293*l.* With subsequent contributions, and a bequest of 500*l.* by our eminent Fellow the late Sir Francis Ronalds, the total, as shown by the balance-sheet now in your hands, amounts to 5,816*l.* 1*s.* 1*d.* In addition to the balance-sheet already referred to, a detailed statement of grants from the Donation Fund is, in accordance with a resolution of Council, published with the Report of the Anniversary Meeting.

Sir Francis Ronalds died in 1873; his bequest (reduced by payment of legacy duty to 450*l.*) was made, as declared in his will, in recognition of the advantages he had derived when Honorary Director of the Observatory at Kew, from the sums granted to him out of the fund to aid him in the construction of his photographic apparatus for the registration of terrestrial magnetism, atmospheric electricity, and other meteorological phenomena.

Of the grants made during the past session, I would especially mention 100*l.* to Dr. Dohrn in support of the Stazione Zoologica at Naples, in which two British naturalists, Mr. Lankester and Mr. Balfour, have recently made a valuable series of observations on marine animals.

Among the others were a grant of 25*l.* to Dr. Carpenter for the purpose of constructing an apparatus to illustrate the theory of oceanic circulation in relation to temperature, and 50*l.* in aid of the Sub-Wealden Exploration. In reference to this last, I should remark that, in recognition of the important scientific results which have been obtained from the Sub-Wealden boring (which is now carried to a depth of 1,000 feet), and in view of obtaining further assistance from her Majesty's Government towards the work, the Council authorised me to lay before the Chancellor of the Exchequer such a statement as I should judge appropriate, with the object of obtaining a grant from the public purse in aid of the boring.

In pursuance of this resolution, I joined the Presidents of the Geological Society and of the Institution of Civil Engineers in presenting a memorial, which was most favourably received, and was answered by a promise on the part of the Treasury of 100*l.* for every 100 feet of boring that should be accomplished, down to a depth of 2,000 feet.

The Government Grant (of 1,000*l.* per annum) continues to be expended with satisfactory results. I must refer you to the report which will be published in our Proceedings for the statement of the grants, making, however, special allusion to Dr. Klein's work on the Anatomy of the Lymphatic System, towards which 100*l.* from this fund was granted, and by means of which copies have been distributed to the best advantage in this country and abroad.

The Scientific-Relief Fund slowly augments, and has been of the greatest service. It is almost unique among charities in costing nothing in the working, and in being inaccessible to direct or indirect canvassing. The amount hitherto expended in relief since its establishment has been 2,240*l.*, extended to fifty-two individuals or families.

The Gilchrist Trust.—One of the most munificent bequests ever made in the interest of science is that of the late Dr. Borthwick Gilchrist, a retired Indian medical officer, well known as the author of the "Grammar of Hindostani."

Dr. Gilchrist was an intimate friend of Dr. Birkbeck, Joseph Hume, Sir John Bowring, and others of the advanced Liberals of fifty years ago, and took part in the establishment of the "London University," now University College. He died in 1841, leaving his large fortune to be devoted, after his wife's death, to "the benefit, advancement, and propagation of education and learning in every part of the world, as circumstances permit," the trustees having an "absolute and uncontrolled discretion" as to the mode of applying it. The income of the Trust, which is being gradually augmented by the sale of building-lots at Sydney, where Dr. Gilchrist had invested a considerable sum in the purchase of an estate with a view to its ultimate rather than its immediate productiveness, now amounts to about 4,000*l.* per annum. The trustees have created various scholarships for bringing young men of ability from India and the colonies to carry on their education in this country; and they have also given assistance to various educational institutions which they considered to have a claim for occasional help from the fund, such as the Working Men's College in London and the Edinburgh School of Arts; and they have instituted short courses of scientific lectures to working men in London, Manchester, Leeds, and Liverpool.

The trustees now desire to do something effectual for the *advancement* of learning; and a scheme—subsequently submitted to the Council of the Royal Society—was suggested by Dr. Carpenter, the secretary of the Trust, as one which seemed to him to be the most effectual for carrying out this object; and it was adopted by the trustees on his recommendation.

In a letter addressed to myself in June last, Dr. Carpenter informed your Council that the trustees of the fund had resolved to employ a portion of it in the promotion of scientific research, and empowered him to submit the following liberal proposal to the consideration of your Council: namely, the trustees propose annually to entertain the question of placing 1,000*l.* at the disposal of the Council of the Royal Society to be expended in grants to men of proved ability in scientific research, but who, from their limited pecuniary means, are precluded from prosecuting inquiries of great interest by the necessity of devoting to remunerative work the time they would wish to devote to such inquiries; the Council of the Society to undertake on their part to recommend to the trustees suitable subjects of inquiry, competent men circumstanced as indicated, and the sum to be assigned in each case. The trustees desire, further, that the grants should not be regarded as eleemosynary, but rather as studentships carrying with them scientific distinction, and not as rewards for past work, but as means for work to be done.

Upon this communication (in which you cannot fail to perceive not only an enlightened regard for the interests of science on the part of the trustees, but, on the part of their secretary, an accurate perception of the best means of supplying one of the greatest scientific needs), your Council appointed a committee to report on the proposal. Their labours are already concluded; the proposition has been accepted, but under stipulation for fulfilment of the following conditions by applicants for the grants:—

That the grants should be made for one year only in each case, though subject to renewal.

That the recipients be designated *Gilchrist Students* for the year in which the grants are made.

That no application for grants be received except it has been approved by the President and Council of any one of the six Societies—namely, the Royal, Astronomical, Chemical, Linnean, Geological, and Zoological; and that all applications be submitted to a committee, consisting of the Presidents of the six Societies together with the officers of the Royal Society, which committee shall recommend the applicants to the Gilchrist Trustees.

That a form of application be prepared setting forth the general objects of the Gilchrist Studentships, and the conditions upon which they are conferred.

That each student furnish, at the end of the year for which the grant is made, a report of his progress and results, signed by himself and countersigned by the President of the Society through which the application was transmitted.

Simple and acceptable as such a scheme appears, it may prove by no means always smooth in the working. It will be easy to find subjects, and candidates too; but the trustees must not expect in every case a full annual harvest for what they annually sow, or that some of the seed will not be productive of a crop of good intentions rather than good fruits. Putting aside all the temptations to procrastination that pre-payment fosters, there is the fact that every subject of scientific research presents a labyrinth in which the investigator may wander further and further from the main gallery, always following some tempting lateral track leading to discovery, but never either reaching the end of it, or getting back to that which he set out to follow.

We must, however, hope for the best results from so munificent an endowment of scientific research, and watch with the deepest interest the progress of an experiment, the means for instituting which, after being urgently called for from the Government and our Universities, are now forthcoming from private resources.

The Wintringham Bequest.—Hitherto this curious bequest has, so far as the Society is concerned, proved alike profitless and troublesome, as will appear from a few particulars of its history.

Sir Clifton Wintringham, Bart., a Fellow and son of a Fellow of this Society, died at Hammersmith, January 10th, 1794, and bequeathed 1,200*l.* Three per Cent. Consols (payable twelve months after the decease of his wife) to the Royal Society, subject to the condition that within one month of the payment of the annual dividends in each year the President should fix on the subjects for three essays in Natural Philosophy or Chemistry, and submit them to the Society to be adopted by secret ballot. The subjects were then to be advertised in the papers of London, Paris, and the Hague: the essays were to be sent to the Royal Society within ten months of date of advertisement, each author to deliver ten copies; and the President and nine members of Council were to choose the best, and then to have made a silver cup of 30*l.* value, to be presented to the successful essayist on the last Thursday in December. In case of failure the dividends were to be paid to the treasurer of the Foundling Hospital.

Lady Wintringham died in 1805; but the Royal Society heard nothing of the bequest until 1839, when steps were taken to obtain possession of the fund. The Foundling Hospital put forward their claim; legal proceedings were taken, costs being paid out of accumulated dividends; and in 1842 the Royal Society were put in possession of the 1,200*l.* stock. Owing to the essential difficulties of carrying out the conditions of the testator's will, the dividends have ever since been paid to the Foundling Hospital.

The Council, desirous that those difficulties should be overcome, have at different times appointed a committee to examine the question and suggest, if possible, a solution; but no satisfactory conclusion has yet been arrived at.

The Handley Bequest.—Mr. Edwin Handley, of Old Bracknell, Berks, was a country gentleman, and the possessor of a considerable landed and personal estate in Berkshire and Middlesex. He died in 1843, having bequeathed the bulk of his property, after the decease of his two sisters, to the Royal Society.

The last of these ladies died in 1872, since when certain legal formalities have been complied with, and the claims of the Royal Society to the landed estates under the Mortmain Act have been brought before the Court. In February last the Master of the Rolls decided that "the gifts to the Royal Society, so far as they relate to pure personalty, are good charitable gifts, but otherwise void." The personalty as set forth in the "Bill of Complaint," comprises 6,033*l.* 7*s.* 5*d.* Three per Cent. Consols, 1,904*s.* 17*s.* 2*d.* Reduced, and 41*l.* 18*s.* 5*d.* Bank of England Stock.

By the terms of the will, the Society is to preserve the property intact in value, as a Fund Principal, the income of which is to be applied to the rewarding inventions in art, discoveries in science, physical or metaphysical ("which last and highest branch of science," to quote the testator's words, "has been of late most injuriously neglected in this country"), or for the assistance of fit persons in the prosecution of inventions and discoveries. The rewards or assistance are to be granted annually, or after longer periods, to British subjects or foreigners, according to the impartial decision of the President and Council.

A delay in distributing the bequest has arisen from the absence of a party on whom it was essential to serve a decree; this has, however, been now served, and there is every reason to believe that the suit will go forward; in which case we may hope to receive the proceeds early next year.

The Dircks Bequest.—Mr. Henry Dircks, of Liverpool, and latterly of London, who died in 1872, has bequeathed the residue of his property (about 4,000*l.*) after payment of debts and charges, to the Royal Society, Royal Society of Literature, Chemical Society, and Royal Society of Edinburgh, in equal shares and proportions, in furtherance of their several objects. As, however, it is possible that certain claims to the residue under the Bankruptcy Act, dating from 1847, may be set up, we are advised that the estate cannot be administrated without the aid of the Court of Chancery, which has been appealed to accordingly.

The Ponti Will.—Lastly, it is my duty under this head to inform you that our secretary has received a communication from the Secretary of State for Foreign Affairs, to the effect that the late M. Girolamo Ponti, of Milan, has bequeathed a portion of his immense property to the "Academy of Science of London." As, however, it does not appear what Society is indicated under this title, and as the relatives of the testator intend to dispute the will, the Council, as at present advised, will take no steps in the matter. I have further to observe that under the terms of the will, the Academy of Science will, if it accepts the trust, be burdened with annual duties and responsibilities respecting the distribution of the proceeds which would be altogether inconsistent with the position and purposes of the Royal Society.

The Fairchild Lecture.—This lecture no longer appears in the annual financial statement of your treasurer. Though an obvious anachronism and regarded almost from the first with little sympathy either within or without our walls, it should not pass away without a notice from the Chair. In February 1728 Thomas Fairchild, of Hoxton, gardener, bequeathed 25*l.* to be placed at interest for the payment of 20*s.* annually for ever for preaching a sermon in the parish church of St. Leonard's on Tuesday in Whitsun week on "the wonderful works of God in the creation, or on the certainty of the resurrection of the dead proved by certain changes of the animal and vegetable parts of the creation." From 1733 to 1758 most of the lectures were read by Archdeacon Denne, one of the original trustees, who in 1746 contributed all his lecture-fees to the fund, which, with a subscription raised by the trustees, enabled them in 1746 to purchase 100*l.* South Sea Stock. Subsequently this stock was offered to and accepted by the Society: the transfer was made in 1757; and from that date the lecturers were appointed by the President and Council. The lectures have been regularly delivered, but of late years to empty pews, under which circumstances the Council, after full deliberation, unanimously resolved that it was desirable to relieve the Society from the Fairchild Trust, and that to this end application should be made to the Charity Commissioners. The regular forms having been gone through, the Trust was transferred to the Commissioners in November last, and thus disappears from our balance-sheet.

The Croonian and Bakerian lectures are given annually as usual; and those of this year appear in our Proceedings. These do not diminish in interest and importance.

The Davy Medal.—The Council has accepted the duty of annually awarding a medal, to be called the Davy Medal, for the most important discovery in chemistry made in Europe or Anglo-America. The history of this medal is as follows:—

Our former illustrious president, Sir Humphry Davy, was presented by the coalowners of this country with a service of plate, for which they subscribed 2,500*l.*, in recognition of his merits as inventor of the Safety Lamp. In a codicil to his will Sir Humphry left this service of plate to Lady Davy for her use during her life, with instructions that after her death it should pass to other members of the family, with the proviso that, should they not be in a situation to use or enjoy it, it should be melted and given to the Royal Society, to found a medal to be awarded annually for the most important discovery in chemistry, anywhere made in Europe or Anglo-America.

On Sir Humphry's death the service of plate became the property of his brother, Dr. John Davy, F.R.S., who, in fulfilment of Sir Humphry's intentions, bequeathed it after the death of his widow, or before if she thought proper, to the Royal Society, to be applied as aforesaid. On the death of Mrs. Davy the plate was transferred to the custody of your treasurer, and, having been melted and sold, realised 736*l.* 8*s.* 5*d.*, which is invested in Madras guaranteed railway stock, as set forth in the treasurer's balance-sheet. The legacy duty was repaid to the Society by the liberality of the Rev. A. Davy and Mrs. Rolleston.

The style and value of the medal, and the steps to be taken in reference to its future award, are now under the consideration of the Council, and will, I hope, be laid before you on the next anniversary. The acceptance of the trust has not been decided upon without long and careful deliberation, nor without raising the question of the expediency of recognising scientific services and discoveries by such trivial awards as medals, and of the extent to which the awards entrusted to our Society are depreciated by their multiplication. My own opinion has long been that some more satisfactory way of recognising distinguished merit than by the presentation of a medal might be devised, and that the award might take a form which would convey to the public a more prominent and a more permanent record of the services of the recipients, such as a bust or a portrait to be hung on our walls, or a profile or a record of the discovery to be engraved on the medal, which might be multiplied for distribution or sale to Fellows and to foreign Academies. In short, I consider awards of medals without distinctive features to be anachronisms; it is their purpose, not their value, which should be well marked; and the question is, whether that purpose is well answered by their being continued under the present form.

Instruments.—The small but remarkable, and, indeed, classical collection of instruments and apparatus belonging to the Society, and for which there was no accommodation in old Burlington House, was, on our migration from Somerset House in 1857, by order of the Council, deposited in the Observatory in the Kew Deer-Park, near Richmond, then under the control of the British Association.

The instruments have been now for the most part brought back and placed in our instrument-room, and will, I hope, at no distant period be accessible to the Fellows.

SCIENTIFIC SERIALS

Cosmos, Guido Cora's Italian Geographical Journal, Nos. 4 and 5 (in one), contains a long and carefully compiled article on Italian travellers in Egypt from 1300 to 1840; Payer and Weyprecht's official account of the Austro-Hungarian Arctic Expedition; and the continuation of F. M. Prscevalski's exploration of Eastern Mongolia and Thibet. There are, besides, Notes on Gordon's Nile Expedition,—an Austrian naturalist, Ernst Marno, has been appointed to accompany Col. Gordon; there is a short account of the travels of a Persian youth, Abdul Kerim, in Tunisia. The part contains an excellent map of the border region between Persia and Beluchistan, compiled from the maps of Major St. John and the English Admiralty.

SOCIETIES AND ACADEMIES

LONDON

Anthropological Institute, Dec. 22.—Prof. Busk, F.R.S., president, in the chair.—Mr. J. Park Harrison exhibited tracings of late Phœnician characters from the south-west of

Sumatra. They are said to be still in use, and differ entirely from early letters in other parts of the island. The natives have a tradition that some descendants of Alexander settled there; and if Nearchus' second expedition, the account of which is lost, reached the Bay of Bengal, the date, Mr. Harrison considered, would agree sufficiently well with the letters. His sailors were principally Tyrians.—Col. Lane Fox read a paper on early modes of navigation, in which he described the various contrivances employed by savage races for transit on the water. Commencing with the simple trunk canoe, the author traced the development of the art of boat and ship-building through the stages of stitched plank canoes, bark canoes, rafts, outrigger canoes, single and double, the double canoe, the variation of hull, the weather platform, the rudder, and the rude sail, and gave the distribution of their many forms and modifications. It was argued that the rude bark float of the Australian, the Tasmanian, and the Ethiopian, the catamaran of the Papuan, the dug-out canoe of the New Zealander, and the built-up canoe of the Samoan, were survivals representing successive stages in the development of the art of shipbuilding, not lapses to ruder methods of construction as the result of degradation; that each stage supplies us with examples of what at one time was the perfection of the art countless ages ago. Some of the more primitive kinds spread over nearly the whole world, whilst others had a more limited area of distribution. Taken together, they enabled us to trace back the history of shipbuilding from the time of the earliest sculptures to the commencement of the art.

Victoria (Philosophical) Institute, Jan. 4.—A paper by Mr. J. E. Howard, F.R.S., entitled "Early Dawn of Civilisation considered in the Light of Scripture," was read by the author.

BERLIN

German Chemical Society, Dec. 14.—A. W. Hofmann, vice-president, in the chair.—Two physiological researches of interest were communicated by Prof. Jaffé, of Konigsberg. Nitrobenzol being poisonous, it appeared reasonable to expect, what experiments fully bore out, that ortho-nitrotoluol, which resists oxidation most completely, should be more poisonous than the two isomeric bodies. *Para-nitrotoluol* is almost without effect upon the health of dogs. Five grains daily were given for several weeks without producing more than a slight inflammation of the mucous membrane of the stomach, and at last jaundice. The urine contained *nitrobenzoic acid* (*para*), but a comparatively small quantity of it only. The rest of the substance had become transformed into *nitrohippuric acid*. This acid was found combined with urea, and therefore insoluble in ether. As in similar experiments, when substituted toluols or benzoic acids had been given to animals, substituted hippuric acids had not been found in the etherial solution, it is not improbable that such acids, though not found, were yet present in the shape of urea compounds. *Para-nitrohippuric acid* constitutes orange prisms, fusing at 129°, and forming well-defined salts with barium and with silver, different from a nitrohippuric acid formerly described by Bertagnini. In the urine of one individual dog a new substance has been discovered by the same *savant* in the following manner:—The alcoholic extract precipitated with H_2SO_4 yielded sulphate of urea, soluble in water, and the sulphate of *a new base*, $C_6H_6N_2O_2$, which combines with one molecule of HCl, but has a sour reaction, and dissolves baryta. It forms prisms, melting and decomposing at 213°. The dog has unfortunately been lost.—Messrs. Forst and Zincke, in re-preparing a product formerly prepared from silver by Limpricht and Schwanert, and described as two substances isomeric with hydrobenzoin and isohydrobenzoin, $C_{14}H_{12}(OH)_2$, have found this opinion to be erroneous; their experiments yielding but a mixture of the two latter bodies. There are, therefore, only two, and not four hydrobenzoins in existence.—M. Wroblewsky described meta-acetyltoluol, prepared from meta-bromotoluol, a liquid boiling at 158°, and yielding isophthalic acid and two isomeric sulpho-acids.—A. Ladenburg has undertaken the useful task of submitting to rigid experiments the opinion generally adopted, that the position of *one* lateral chain in benzol is indifferent with regard to the substance thus constituted; in other words, that no isomeric aromatic bodies can exist with only one lateral chain. He showed this time the identity of ordinary benzoic acid with benzoic acid prepared from phenol, and the complete identity of the three phenols prepared from the three different oxybenzoic acids. The proof will have to be completed by further researches, in which Mr. Ladenburg is still engaged.—Messrs. Michaëlis and Ananoff have undertaken researches respecting the constitution of phosphorous acid, for which they have established the formula $HP = O(OH)_2$. Without entering into details, we can only say that the method consisted in the action of $C_6H_5PCl_4$ on phosphorous acid, when no phosphorous chloride, PCl_3, but only oxychloride, PCl_3O, was formed. They have also prepared a monobasic phenylphosphorus acid, $C_6H_5P = O(OH)H$.—Prof. Nilson, from Upsala, described as the best method for extracting *selenium* the treatment of the flue-dust with cyanide of potassium.—T. Piccard has found in the sperma of the salmon, besides a new base, *protannin*, lately described by Mieschke, also *sarkin* and *guanin*.—C. Schisbler described a volumetric method for determining CO_2 in carbonates without introducing temperature and barometric pressure into the calculus. The method consists in making a "normal" analysis with a pure carbonate and comparing the volume of CO_2 obtained with that of the unknown quantity of CO_2 yielded by the substance analysed the same day.—H. Uppenkamp described hexylic sulphocyanide and isosulphocyanide.—C. Biedermann and L. Ledoux reported on the formation and properties of mesitylenic phenol, $C_9H_{12}O$.—A. W. Hofmann communicated his researches on fractions of beech-tar distilling above 260°. By oxidation they yield a phenolic substance, $C_{11}H_{16}O_3$, in which H_2 may be replaced by Br_2, and a quinone, $C_3H_8O_4$, which takes up H_2 when treated with reducing agents. Prof. Hofmann further reported on the following experiments of Mr. M'Creath:—The action of water on guanidine, CH_5N_3, consisting in the loss of ammonia and the formation of urea; the action of anhydrides has been studied, when it was found that benzoic anhydride acts on guanidine in a similar way, producing ammonia and dibenzoyl-urea.—A. Oppenheim has submitted crystallised pure glycerine to distillation. The boiling point corrected proved to be very constant at 290°. Nearly every manual and dictionary of chemistry contains erroneous data in this respect, although the same number has already been published in 1860 by Mendelejeff.

PARIS

Academy of Sciences, Dec. 28, 1874.—This was the anniversary meeting of the Academy, an account of which appeared in last week's NATURE, p. 178.

BOOKS AND PAMPHLETS RECEIVED

COLONIAL.—On the General Theory of Duplex Telegraphy: Louis Schwendler (Asiatic Society of Bengal).—On Earth Currents: Louis Schwendler (Asiatic Society of Bengal).—Second Annual Report of the Secretary of Agriculture of Victoria (Melbourne, Australia).

FOREIGN.—Anthropologische Beiträge: Georg. Gerland (Max Niemeyer, Halle).—Classification de 160 Huiles et Graisses Vegitales. and Edition: M. Bernardin (Annoot-Brackman, Gand).—A. Dobsinai Jegbarlang: Dr. Krenner Jozef Sandor,—Die Eishöhle von Dobschan, Dr. Jos. Alex. Krenner (K. Ungar, Budapest).—Jahrbuch der Kaiserlich-Koniglichen Geologischen Reichsanstalt, Band xxiv. (Wien)—Az Arapály Fuinei Obölben: E. Stahlberger (K. Ungar, Budapest)—Essai sur la Vie et les Ouvrages de L. A. J. Quetelet (F. Havez, Brussels).—Verdhandlung des Naturhistorischen Vereins der Preussischen Rheinlande und Westfalens: Dr. C. J. Andrà (Max Cohen und Sohn, Bonn).—Sitzungsberichte der neiderrheinischen Gesellschaft für natur, und Heilkunde zu Bonn (Max Cohen und Sohn, Bonn)—Memoires de la Société de Physique et d'Histoire Naturelle de Genève, vol. xxii. Part ii. (Ramboz et Schuchardt, Genève).

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THURSDAY, JANUARY 7.

ROYAL INSTITUTION, at 3.—On the Voltaic Battery: Prof. Gladstone, F.R.S.

FRIDAY, JANUARY 8.

GEOLOGISTS' ASSOCIATION, at 7.30.—Special General Meeting.—The Geology of Brighton, Part II.: Jas. Howell.

LONDON ANTHROPOLOGICAL SOCIETY, at 7.—Anniversary Meeting.

SATURDAY, JANUARY 9.

ROYAL INSTITUTION, at 3.—On the Voltaic Battery: Prof. Gladstone, F.R.S.

SUNDAY, JANUARY 10.

SUNDAY LECTURE SOCIETY, at 4.—Indian Temples and Scenes in India: Capt. Lyon.

MONDAY, JANUARY 11.

GEOGRAPHICAL SOCIETY, at 8.

TUESDAY, JANUARY 12.

ROYAL INSTITUTION, at 3.—Pedigree of the Animal Kingdom: E. Ray Lankester.

ANTHROPOLOGICAL INSTITUTE, at 8.—The Anthropology of Prehistoric Peru: Thomas J. Hutchinson, late her Majesty's Consul at Callao.—On the Andamans and Andamanese: G. E Dobson, F.L.S.

PHOTOGRAPHIC SOCIETY, at 8.

METROPOLITAN SCIENTIFIC ASSOCIATION, at 7.

WEST LONDON SCIENTIFIC ASSOCIATION, at 8.

WEDNESDAY, JANUARY 13.

GEOLOGICAL SOCIETY, at 8.—On the Kimmeridge Clay of England: Rev. J. F. Blake, M.A.—On the Cambridge Gault and Greensand: A. J. Jukes-Brown.—The Glaciation of the Southern part of the Lake-District and the Glacial Origin of the Lake-basins of Cumberland and Westmoreland: J. C Ward.

SOCIETY OF TELEGRAPH ENGINEERS, at 8.

ROYAL SOCIETY OF LITERATURE, at 8.—On the Classification of Manuscripts, chiefly in relation to the Classed Catalogue in the British Museum: W. de Gray Birch.

THURSDAY, JANUARY 14.

ROYAL INSTITUTION, at 3.—Physical Geography: Prof. P. M. Duncan.

LONDON MATHEMATICAL SOCIETY, at 8.—The Solution of Linear Differential Equations in Series: J. Hammond —On the Potential of the Ellipse and the Circle, and Determination of the Attraction of an Ellipsoidal Shell on an Exterior Point: Prof. Cayley, F.R.S.—Construction of a Slide Scale: Major J. R. Campbell.

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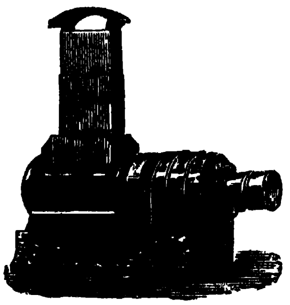

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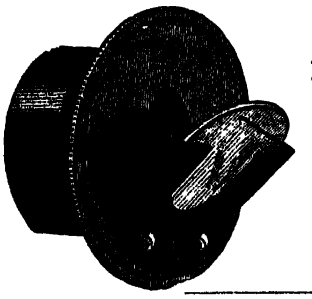

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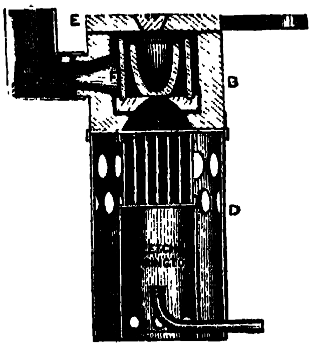

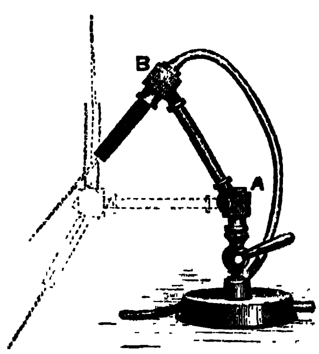

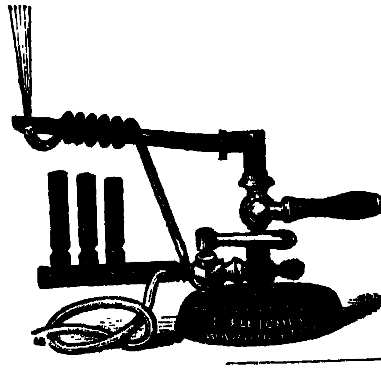

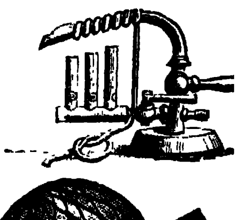

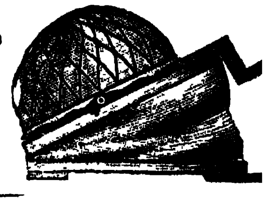

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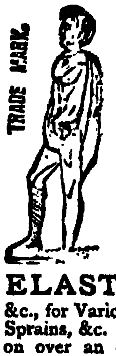

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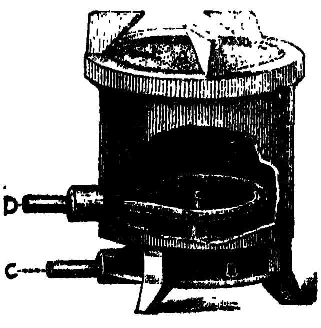

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ON OSTEOLOGICAL MONOGRAPH-WRITING

IN biological Societies, and in others which have any biological interests, there is a question which is daily becoming more and more prominent; one that if not fully investigated shortly will lead to results which are far from advantageous to the science itself, and will throw discredit on its votaries; whilst, if some decided opinion is expressed in such a manner that no doubt can be entertained as to its true meaning, much hard work and unnecessary disappointment may be easily saved.

Some half century or so ago, when zoology was just commencing a new lease of life, as it may be termed, the opportunities afforded to those who were studying the anatomy and physiology of the animal kingdom were comparatively few. Museums were scarce; most of those existing being very incomplete in an educational point of view, and it was almost impossible to procure specimens of any desired species by means of a pecuniary offer. The case is now, however, extremely different. Museums are numerous, and are daily becoming more so. The facilities for locomotion make it easy for anyone anxious to see what cannot be obtained nearer, to visit the British Museum or that of the Royal College of Surgeons; there are dealers who are able to offer typical specimens at a moderate price, and to obtain the rarer forms if necessary. Such being the case it must be evident that a certain change ought to have come over zoological literature, in order that it should progress with the science itself. What was then indispensable is now no longer required, and that which was then unknown takes its place. Nevertheless there are a few comparative anatomists who do not seem to realise the change which has so gradually and so markedly occurred. They think and write with the ideas of fifty years ago, and, what is more, expect us to appreciate their productions as if they were not the least *de trop.*

Formerly, no doubt, it was extremely valuable to have descriptions given in print of the detailed anatomy of particular species. Of their osteology this was especially the case. These descriptions drew attention to previously scarcely recognised characters, and, what was perhaps still more important, did much to fix the nomenclature of the skeleton generally; because, though this had been previously accomplished as far as human anatomy is concerned, there are many reasons, known to all practical students, which make the names adopted in anthropotomy unsatisfactory and incomplete when they have to be applied to the lower vertebrata.

The case is now very different. Skeletons of almost all known animals being contained in museums, and those of common species being abundant, any student prosecuting his investigations in the spirit which insures successful results, will find no difficulty in obtaining opportunities of handling and comparing the bones themselves, and will have but little or no need to refer to plates or descriptions, which are never so satisfactory as the specimens themselves, and are often as difficult to obtain as they are expensive to purchase.

It therefore becomes a question, and a not unimportant one either, as to whether it is to the best interests of our learned Societies to expend their funds in encouraging the further publication of long and exhaustive descriptions of the osteology of common types, and the execution of a large number of elaborate drawings of bones, whose intrinsic worth is considerably less than the cost of their putting on wood or stone. In several instances within the last two or three years, lengthy papers, without doubt the result of much time and attention, have been presented to different Societies, evidently with a full idea on the part of the authors that their monographs will be published, unopposed, in the form in which they send them in; and yet these many pages are found to contain nothing more than the monotonous and unsuggestive descriptions of the bones, one by one, and surface by surface, profusely illustrated, of animals as common as some of the best-known Marsupial mammals or Struthious birds.

A full account of the myology, neurology, or visceral anatomy of almost any animal has a value which no one would wish to depreciate in the least, because these parts are difficult to preserve, and it requires a special training, together with considerable experience in one direction, before such investigations can be undertaken, as they are but too infrequently. But as bones are so easily preserved in a state which cannot shock the most delicate hands or the most sensitive nose, there is no excuse for any student not practically knowing the most important peculiarities of any skeleton, nor for his not prosecuting his investigations to any degree of minuteness when occasion requires.

It has been remarked that these fully illustrated monographs are of especial value in palæontological investigations; that the study of the Pleistocene remains of Australia, for instance, can be conducted on the spot with greater facility when comparisons can be made with existing forms. But, we may ask, where can it be easier, than in Australia itself, to obtain the skeletons of now living Marsupials? and we all know how much better it is to have the bones themselves than drawings of them, however well executed. Further, it has been said that after a certain time it is impossible for any author, however able, to continue to develop generalisations and theories from any number of fresh facts; and such being the case, can those who really like their subject do better than devote themselves to the careful description, uncomplicated with any attempt at inductive reasoning, of what they have the opportunity of observing? We think they can, for we see no reason why the inferior productions of an able man should, on account of his previous reputation, be allowed to be placed on a level with the better work of others, and above those productions of the same quality, the attempts of less known authors.

The fact, however, is that the time is passed for the publication as simple statements of the commonplace facts of osteology; the subject is more than overloaded with them already. What is now wanted is the application to them of some methods by which, like the doctrine of evolution, or the vertebrate theory of the skull, those at present on hand may be turned to better account in determining the true affinities of different animals, or the means by which the present state of things has been arrived at. The comparison of simple fact-accumulation to the introduction of fresh methods of research, or lines of thought, is so insuperably in favour of the latter, that the former has quite descended below the level of that quality of work which needs the distinguishing encouragement afforded by the publication of the results obtained in the "Transactions" of any learned Society.

PICKERING'S "PHYSICAL MANIPULATION"

Elements of Physical Manipulation. By Edward C. Pickering, Phayer Professor of Physics in the Massachusetts Institute of Technology. Part I. (London: Macmillan & Co., 1874.)

TO write a satisfactory text-book for students in physical laboratories is a task beset with difficulties; and although Prof. Pickering has had the advantage of no small experience and judgment in the composition of the work the title of which is given above, we do not think that he has entirely overcome them.

There can be little doubt that oral teaching is that which is best suited to students who are beginning experimental work of any sort, and that as much may often be learnt in five minutes by seeing another perform an experiment as would be acquired in as many hours with the aid of a book alone to explain the construction and use of the apparatus; and Prof. Pickering is therefore right in aiming at supplementing rather than superseding the efforts of an instructor.

The work is divided into sections, each of which relates to one or more experiments, and comprises two parts, the first of which, entitled "Apparatus," gives a description of the instrument required, and is designed to aid the instructor in preparing the laboratory for the class, while the second, headed "Experiment," explains in detail to the student what he is to do.

The subjects treated of in the first volume, the only one at present published, are Mechanics, Sound, and Light, an arrangement that does not agree with the order in which they would probably be studied in the laboratory, as the elementary parts of heat ought certainly to be taken with mechanics; but the plan adopted has the advantage that heat and electricity, the subjects in which tables are most required for reference, will be placed together in the second volume, in which also, we presume, sets of tables will be included among the "matters of general interest to the physicist" that are promised in the preface.

Apart, however, from any detailed criticism, we must notice the important preliminary question, how far a work of this sort is likely to fulfil the object with which it is written, of enabling an instructor to superintend a larger class than he could otherwise attend to at once? The members of the class, according to the method of instruction pursued in the Massachusett's Institute, and described in the preface, are not informed precisely what experiments will be allotted to them until they enter the laboratory, and as such is the plan probably generally adopted where the number of pupils is large, it is absolutely necessary for the instructor to have at hand, either in a text-book or in manuscript, short papers on the theory of the different experiments. We do not, however, feel sure that the descriptions of apparatus and methods of performing experiments will prove so valuable as might at first sight appear probable. The instruments required for physical work are often so costly as to make constant supervision necessary over those who are not accustomed to them, and their construction is so various, at all events in minor particulars, that directions for their use which might be all that could be desired in one laboratory might be misleading in another. Another difficulty arises in describing experimental proofs of the simpler laws of Mechanics and Physics which do not require elaborate apparatus for their exhibition, as a choice has often to be made between several different methods, an account of all of which would make the text-book unwieldy in bulk, while the omission of any is apt to make it less useful in laboratories other than that for which it was originally intended. The selection of experiments of this sort must in great measure depend upon the time the pupil is able to devote to the study of physics, the objects he has in view in pursuing it, and in many cases upon his knowledge of mathematics; and we regret that Prof. Pickering seems occasionally to have chosen those which are likely to give the best numerical results, in preference to others which, depending more upon skill, are not indeed so suitable for the exact verifications of physical laws, but have a greater educational value in improving the powers of observation.

The method selected, for instance, for illustrating the laws of falling bodies is that of suspending a ball to a spring, which, when the connecting thread is severed and the ball allowed to fall, completes a galvanic circuit in which a chronograph is included, and which is again broken by the impact of the ball on a plate placed below to receive it. This method is well adapted to show the relation between the time of falling from rest and the distance traversed; but Attwood's machine, of which no account is given, illustrates the fundamental laws of dynamics much more completely, is capable, if fitted with proper electric arrangements, of giving extremely good results, and is better suited for use by the pupil, as in our opinion all such instruments ought at first to be used, with some means of measuring time, such as the stop-watch, water-clock, or metronome, dependent upon skill, and not upon a purely mechanical arrangement.

Some of the experiments described are avowedly given as a preparation to those who may have to give lectures on physics, and others are, we presume, inserted with the same intention, as it would hardly be necessary for those possessing that "moderate familiarity with the general principles of physics" which "the class is supposed to have previously attained" to spend time over the experimental proofs given of the laws of the composition of forces, or the equality of the angles of incidence and reflection.

The earlier pages of the book are devoted to general remarks on physical measurements, and on methods of working up the results of experiments, and they will prove very useful.

The knowledge of mathematics assumed throughout is small, and in several instances the line has in this respect been drawn too tightly, no account being given of the method of determining the coefficient of torsion by means of the torsion pendulum, or of the determination of gravity by the reversible pendulum, probably on account of the small amount of rigid dynamics required in these problems.

In a book, however, which must necessarily be intended for use by pupils of very different attainments, it would be difficult to avoid criticisms of this kind, and we think the experiments on the whole judiciously selected and clearly explained. We shall look with interest for the appearance of the second volume, and when finished "Physical Manipulation" will no doubt be considered the best and most complete text-book on the subjects of which it treats. A. W. R.

OUR BOOK SHELF

Mineralogy. By F. Rutley, F.G.S. (Murby's Text Books.)

MR. RUTLEY'S little treatise on mineralogy has the merit of expressing in a clear and simple form the facts that are most wanted to be known by the general student of a science for which a small elementary English book is needed. The descriptions are concise, and the selection of the matter under each mineral generally good. Mr. Rutley, furthermore, gives some fifty pages of preliminary matter, which, though not always put in the most intelligible form, yet embodies a considerable amount of useful technical teaching in regard to the physical properties of minerals. Mr. Rutley even enters, and very rightly does so, on the subject of optical characters. But in these pages, as in the page on thermo-electricity, the author does not seem to have carefully revised what he wrote, or he would not have followed other authors in speaking of boracite as a uniaxal crystal, and would hardly have classed the dispersion of light by a diamond with the play of colour exhibited by an opal. Nor is an optic axis correctly described as the only direction by looking along which the doubly refracted images of a spot can be got to coincide, as Mr. Rutley will see if he looks at the spot through two opposite faces of the hexagonal prism of a calcite crystal. He ingeniously endeavours to indicate the nature of the faces of his crystals by a sort of heraldic hatching and marking. The use of small letters always indicating the character of the faces, as in Des Cloizeaux and other French treatises, might have done this usefully; Mr. Rutley's puzzling figures will probably only serve to scare away the English student, who needs every allurement to the study of the neglected science of crystallography—a science neglected merely because the rudiments of geometry and trigonometry are not made a necessary part of every scientific student's education. And it is a significant circumstance in connection with this neglect of scientific crystallography, that the geometrical methods and simple notation introduced forty years ago by our distinguished fellow-countryman, the first living crystallographer, Prof. Miller, are, we believe, untaught in any single lecture-room in London. Is England to be the last country to adopt a system made European by Sénarmont, Sella, Beer, and Grailich, and which is fast overcoming even in Germany itself a natural prejudice in favour of the more unwieldy, though in its time useful and ingenious, notation of the great Leipsig Professor?

Sanitary Arrangements for Dwellings, intended for the use of Officers of Health, Architects, Builders, and Householders. By William Eassie, C.E., &c. (Smith, Elder and Co. 1874.)

THIS volume gives, in a collected form, a series of papers published originally in the *British Medical Journal.* Its object, the author states, is to give "an account of the most ordinary sanitary defects in dwelling-houses and public institutions, in respect to drainage, water-supply, ventilation, warming, and lighting;" and "to set forth,' what he believes, "the most simple and effective means of *preventing* or *remedying* such defects." He thinks it necessary to say further:—"The purpose of this small work is to point out, in the plainest language, what ought to be done to render ancient and modern houses healthy. I will eschew all extraneous matter, as much as possible, and will not fall into the common practice, better honoured in the breach than the observance, of heading the chapters, or interlarding the matter, with lines from the poets." It is but due to the author to say that he has faithfully avoided this tendency "to drop into poetry" on the subject of house-drains, sewers, &c.; on the plainness of the language, however, we cannot speak very highly. Many householders, it is to be feared, will find some difficulty in recognising an S-shaped pipe under the name of a "sigmoid"; or in appreciating the beauty of a description in which the overflow sewage from a cesspool is said to "debouch into the fields."

The greater part of the book is occupied with a description of the various sanitary appliances for buildings which have from time to time been proposed, or which have been brought into actual use: such as drain-pipes, of which twenty-two different kinds are figured and described; traps, of which thirty-six are given; fire-grates and stoves, &c. In many places, indeed, it reminds us of nothing so much as a manufacturer's or tradesman's catalogue. On the whole, however, this work contains much useful information and many excellent suggestions. On the subject of house-drainage, we are glad to see that Mr. Eassie has adopted and advocates the principle of leading all house-drains into one collecting drain, outside the house if possible, and placing in this main drain an efficient trap, properly ventilated, so as to prevent any of the sewer gases finding their way into the house through the drains or pipes.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Robert Brown and Sprengel

IN the notice of Mr. Darwin (vol. x. p. 80, bottom of 2nd col.) a mishap has somehow occurred which blunts the point intended to be made prominent and renders the statement untrue. I supposed that I had written "*And* we know from another source that he (Mr. Brown) looked upon Sprengel's ideas as *by no means* fantastic. Yet instead," &c. The object was to show how very near Mr. Brown came to reaching the principle that Nature abhors close-fertilisation in plants, and yet did not reach it at all. The authority for the statement I wished to make will be found in a footnote in Mr. Darwin's book on the "Fertilisation of Orchids," p. 340. ASA GRAY

Cambridge, Mass., June 19

On the Physical Action taking place at the Mouth of Organ-pipes

THE most interesting, and perhaps the most important, fact disclosed in the experimental study of the organ-pipe on the air-reed theory is this—that the aeroplastic reed has a law of its own, unique amongst the phenomena heretofore observed in musical vibrations. It may be stated thus—*As its arcs of vibration are less, its speed is greater.* All our knowledge of rods and strings, of plates and membranes, would lead us to expect the usual manifestation of the law of isochronism, that in the air-reed considered as a free rod fixed at one end and vibrating transversely, the law would be observed, "though the amplitude may vary, the times of vibration will be the same." Yet here we meet with its absolute reversal, viz.—*the times vary with the amplitude.* This information does not rest on theory; every eye may verify it. A principle so strange, when first its action was observed, might well lead to disbelief in one's senses, although the mind had by its reasonings led up to the fact and sought for it as the one thing needed to give consistency to theory and make it a perfect whole. Familiar as the air-reed had been to me, the one secret had been hidden from my eyes; seeing, they saw not. Faith in the known mode of activity of the transversely vibrating rod had blinded me, and it was only after long reasoning, forced upon me by the presence of independent harmonics, not upon any theory belonging to a reed (whose first harmonic would be higher than an octave twelfth), that my faith was shaken. Then, conceiving the idea of this principle of action, I looked, hoping to find my reasoning confirmed; yet, let me confess it, the first sight of the reality startled me not a little with self-confusion. Here was an every-day fact, constantly before me it had been, beautiful in its simplicity, waiting to be acknowledged, and I so stupidly blind as not to see it. Vary the experiment, repeat it again and again, and the fact will be confirmed beyond possibility of doubt, that, the length of reed remaining unaltered, if by extraneous influence the pitch of the note is lowered whilst the pipe is speaking, correspondingly with the changing sound the path of the air-reed will be lengthened; or conversely if the pitch be raised, simultaneously with the quickened velocity, the air-reed will be seen to shorten its stroke; no swelling of tone gaining power with gain of amplitude; not the counterpart of a metallic reed, nor acting as a tuning-fork. The creature of air, it times itself to the element that sustains it. This aero-rhythmic law provides the only way possible to the air-reed to work out the transmutations of energy essential to its functions; the constitution of air necessitates the conformity in mechanical relations.

Another remarkable demonstration falls to this theory—that the note of every open organ-pipe is not single but is a concord, always consists of a duality of tone; the two distinct tones of the air-reed and of the pipe may be separated and again blended at pleasure.

Also that the harmonics or over-tones may in favourable pipes be brought on at will without alteration of the pressure of blowing; that likewise, when a pipe, instead of continuing to sound its fundamental, is unsteady, and gives its harmonic, the pipe being said to "fly off to its octave," the notion implied is erroneous; it can be rendered visible that the air-reed leaps back to its octave speed, and by its superior strength compels the pipe to follow in accord. The expression "leaps back," is deliberately used, for the native pitch of the air-reed is far higher than the harmonics of the pipe.

Add to these the still more singular feature of three different velocities concurring to produce in an open organ-pipe the one fundamental tone, which we call its pitch, the super-nodal wave having one velocity, and the sub-nodal wave having for its course and recourse two differing rates of progression. *The motion of vibration is an activity tempered by rests.* In every wind-instrument we perceive intimations that the period of rest is originally governed by the special structure of each, and experiment shows that we can arbitrarily limit or prolong it; this variable ratio of rest to activity is to be taken into account in all calculated times and velocities. In forming a true conception of the behaviour of musical reeds, and in tracing out the process of tone-making in organ-pipes and other wind-instruments, the modifying influence of the "rest" between the vibrations announces itself as of vital importance. If the doctrine is strange, it is not unnatural. The action of the heart furnishes a parallel instance—contraction, dilatation, pause—the three making up the rhythmic period of the heart's beat, and their relative duration varying with the individual organisation.

The foregoing affirmations are preparative. It will not be possible to condense into one letter the evidence and arguments supporting them, but if they are borne in mind during the progress of the exposition, the bearing of each new fact on theory will be more readily seen, and the aim and purpose of the reasoning be apprehended even in its incomplete stages.

There is one significant question which it occurs to me has never yet been asked; that the node is to be found in all longitudinal vibration of rod or pipe is undoubted; that there is a displacement of a node in an open organ-pipe is an accepted fact—but why, in rod or pipe, why is there a node at all? The question will wait.

Now to the experimental pipe. Suppose we have before us an open diapason organ-pipe, of section rectangular, length 7 ft. 6 in., interior breadth $4\frac{1}{8}$ in., depth 6 in., area of mouth $4\frac{1}{2}$ in. by 4 in., pitch C.C.—the half wave-length for this pitch is 8 ft. 8 in. in the atmosphere. The wind-way is a narrow fissure, barely the twenty-fourth of an inch wide; on the inner margin of this wind-way we place a card or plate, covering interiorily the whole area of the embouchure, and then we admit the wind-current at the foot of the pipe from the organ-bellows.

Premising that the swift sequence of action is delayed for convenience of our analysis, we notice that the stream of air, and as yet it is nothing more, is directed slightly diverging from the vertical, and sufficiently to cause it to glide up the inclined plane of the lip. This stream is the life-force of the sound. "That everybody knows." True they may. But how many ever think, if they know, that its force is that of a storm-wind driving along at the rate of sixty miles an hour. The anemometer or wind-gauge proves it to be so, and that moreover in some stops of large organs the pressure per foot given by the bellows is equal to that of a hurricane.

If now the plate be removed from the back of the embouchure, the stream is instantaneously transformed into an air-moulded reed. There is gradation in the change, the order of which may be worked out, leaving the sound as Shelley says "waiting to be born."

The velocity *of passage* is to become endowed with a new power, the velocity *of vibration*. How is this investiture accomplished? How afterwards does the transversal vibration of the aeroplastic reed call into existence the longitudinal vibration of the air-column of the pipe?

The isolated reed, before any change takes place, has no innate tendency to swerve from uprightness, of itself it can neither blow in nor out, nor can the atmosphere influence it, for that is equal on both sides; the air-column within the pipe is at rest, it has no self-stimulating power of vibration, and to disturb its equilibrium some internal exciting cause is needed which shall produce, with determination of priority, condensation or rarefaction. It is obvious that the reed as it now stands has no power to produce a condensation, it does not strike against the sharp edge, it simply asserts its own upward-rushing force. The reed must be bent before it will vibrate. To cause this flexure the only alternative is rarefaction. The act of rarefying occupies time, it takes place within the pipe, is not spontaneous, but is induced by some previous act, therefore the provocation belongs to the reed. In velocitous rush over the mouth, its dense stream making around itself a rarefied atmosphere, it causes the approach of the quiescent column, carries off all the particles of air lying in the nearest layers, and would go on abstracting indefinitely if there were no counterbalancing causes coming into operation, but it brings down upon itself the power that bends it; *suction by velocity* has created a partial vacuum; the air-column, pressing outwards with the impetus of expansion, begins to bend the reed over, the excited air-particles of the interior not only press forward to fill the places of the lost, but eagerly crowd out upon the top of the reed, irresistibly sucked into the zone of rarefaction around the mouth, a region where velocity has ensured least pressure, and through this same "law of least pressure," there is a loss of support to the under surface of the reed, favouring the curve of flexure, the pressure varying and diminishing from the root upward.

As yet we have no vibration, for simultaneously with the exterior action the interior rarefaction is extending high upward, the air-particles are rallying from further distances, awakened by the agitation of those in advance, throughout the whole length and breadth of the pipe, uneasy as bees in a hive; whilst the particles are swarming toward the mouth, they are drawing away from the main body of their supports, their own elastic energy is diminishing, they are more and more thinned in numbers, and the new levies come up to the front exhausted of their early vigour. Now is the supreme moment of the reed's advantage, its watchful ally, the external air, pierces the weakest line just under the sharp edge of the lip, and dashing in as a wave of condensation with cumulative pressure, drives back the outflowing wave, and would restore equilibrium but that the air-column, still advancing, and pressed forward in consequence by the inroad of the upper air, meets it in full shock ere it has reached midway; meanwhile the air-reed, rising with vigour to recover its upright position, and following after its ally in the wake of the retreating column, slightly overpasses its own line, enters the pipe momentarily to be cast out again, for the wave of rarefaction is returning and vibration is established. The invading wave has been repulsed at the spot hereafter memorable as *the node*, and the conflict renewed and continued will chronicle no victory to either unless other and foreign forces are brought in, for, as I shall show, we have resources within command enabling us to sway the equipoise and give supremacy to the reed.

"I do suppose," as Dr. Hooke says in his talk on "springy bodies," "I do suppose the particles" behave, and that the action takes place in the manner I have described; the analogy is not strained, nor have I used one phrase in association of ideas which I do not think fully justified by the physical relations of the process. Therefore do not dismiss this as the sketch of a fancy battle. Watch for yourselves; place within the pipe at the back of the mouth some fine filaments of cotton, or fluff or down; advance them from the interior to the inner edge of the windway, and you will see them shot with energy not upward into the pipe, but outward full in your face with an unmistakeable trajectory. Do we not bring into activity the same force, "suction by velocity," when we blow through one little tube over another tube leading down to a well of perfume and draw up thereby scent-laden globules caught in the belt of wind passing over the tube's orifice, dispersing fine odour-sprays into the atmosphere? When a train of carriages loosely coupled is starting out of a railway station, should the engine suddenly back a little we see the hindermost portion of the train with its acquired momentum meeting the foremost portion advancing to it with reversed direction of impetus, and the central carriages receive a double compression, a rude kind of node is thus formed starting a reaction of bufferage in opposite directions; so when trains come into collision or are suddenly stopped in career, the distribution of weight, the gradients and relative velocities determine which portion feels most the influence of the shock. Again an analogy. There is a country custom, when the bees swarm to dredge them with flour as a means of identification, if the flour *travels* you will know the bees have journeyed likewise. Take a piece of white tissue paper (a banknote answers it admirably), fold it so that a portion will occupy very nearly the space of the embouchure of the diapason pipe, by using a card it may be held level on the outer edge of the windway, it is in fact a paper reed but flaccid and inanimate; as you advance it to the windway no sooner is it caught in the current than it darts upright and becomes incorporated with the air-reed,

> "Grows with its growth and strengthens with its strength."

This same crisp little bit of paper will reveal to your eyes the treasured secret of the organ-pipe, tell you how its wealth of varied tone is wrought, show you its fine arcs of flexure, how it bends less for its inward than for its outward stroke, and how its free curves are moulded to your will; listen, and you shall hear the domestic wrangle of the reed and pipe; look, and you shall witness how in its high caprice it transmutes in a flash to harmonic speed and leaps exultant to its octave. Truly an Ariel imprisoned, endowed with form, and clothed with a white vesture making it in all its motion visible as bees.

On the supposition that the theory herein advanced is justifiable, the work of the aeroplastic reed is to be considered, specifically, *to abstract*. By reason of abstraction rarefaction ensues, condensation correlates therewith, the latter springing out of the former, and the product is vibration. The reed is the generator of the power and the node is the fulcrum of vibration, the place of reaction, with this peculiarity that it affords an elastic fulcrum sensitive to the encroaches of the column of air above it; in the stopped pipe on the contrary there is a stable unyielding fulcrum, and the results of this difference are very remarkable, as will be seen in another paper necessary to complete this exposition, but at present I can only allude in passing to one of these results which it seems desirable not to omit here. Admitting my affirmations so far as they can be proved by other eyes, objections will be taken to the imaginary description of the action of air-particles and waves in the interior of the pipe, as opposed to received doctrine. Novelty is often held to be outrage. It is an essential feature of my hypothesis that the initial movement, or prelude to vibration in the pipe, is distinct from successive movements both in its course and character; it extends throughout the pipe, is continuous but diminishing in degree, and is without a node, which is only fully established at the second course. Without entering now into further details it is important to notice that this interval between the first effort or gasp of the pipe and the full possession of its power, is distinctly perceived by the ear. All musicians acquainted with organs are conscious of this, and it is matter of usual comment with them how that stopped pipes are on the contrary remarkably quick of speech, instantaneous in articulation. They feel this without reasoning of why or wherefore. As in stopped pipes there is no supernodal column, no requirement for an effort similar to that awakening motion to perfect vibration in open organ-pipes, the verdict of the ear is in both cases consistent with and corroborative of the hypothesis. Experiments with a very peculiar pipe called the "German Gamba" will throw invaluable light on the process of tone-making in organ-pipes.

HERMANN SMITH

The Degeneracy of Man

WITH regard to the culture of savages in Brazil the evidence of facts will be more esteemed by Mr. Tylor than the opinion of Dr. Martius, for Mr. Tylor has brought together a wealth of facts on the history and conditions of culture.

There is one class of facts which to my mind bears particularly on this question of the tribes of Brazil and the Amazons, and that is language.

The Kiriri and Sabuyah of Bahia as also the Ge have affinities with the Shoshoni and other dialects of the Rocky Mountains, and it is difficult to believe a language of this kind can belong to an epoch of high culture.

The dialects of the Tocautius have affinities of a like character with the Ankaras and Wun of Africa, and with that of the Akka pigmies just discovered in the Nile region.

The Purus, Coroado, and Corope of Rio Janeiro appear to belong to the Carib directly, and thereby also to Africa.

In the present state of our materials and information it is impossible to define exactly the members of each class. Thus the two groups last mentioned appear to be connected by the Baniwa and the Carib.

The main body of the population of Guarani, Tupi, Omagua, have by me been long since pointed out as having a language similar in roots and grammar to the Agaw of the Nile region. This is the highest development of language known to me in Brazil.

If the tribes of Brazil have fallen from a higher estate it is strange they should have become endowed with languages of the Prehistoric epoch. HYDE CLARKE

June 29

THE gradual degeneracy of savage man from a higher type is a fact which an eminent author states in his letter in NATURE (vol. x. p. 146) to be difficult of belief. He wonders that Dr. Martius should say "the Americans are not a wild race, they are a race run wild and degraded."

The following facts seem to me to support the view held by Dr. Martius, Alex. von Humboldt, Abp. Whately, the Duke of Argyll, and others.

In the Ilium now laid bare by Dr. Schliemann, the lower strata contain more copper and fewer stone implements than the upper. "In other words, we have the very 'unscientific' fact of an 'age of stone' above an 'age of copper'" (Quart. Rev., April 1874). "The newly opened mound of Hissarlik stands as a lasting witness to a progressive decay of civilisation, industry, and wealth, among the successive races of its inhabitants" (Quart. Rev.).

Among the forest tribes of Brazil Dr. Martius found traces of the village community with its tribe-land common to all, while huts and patches of tilled ground were treated as acquired property, the recognised owners not being individuals but families. This may be well explained as a custom brought by Asiatic immigrants into the American continent. The Chinese anciently divided the land of a village into nine parts. The division was made by two perpendicular and two horizontal parallel lines. The middle square was common land. The eight remaining squares were assigned to eight heads of families, who cultivated the common square, giving the produce to the Government: they constituted a village. This principle of revenue collection based on land distribution existed for many centuries in ancient China, and was afterwards changed for a grain tax in kind about the time of the building of the Great Wall. Agricultural emigrants to America at any date before 200 B.C. would be familiar with this mode of doing things, and would naturally carry with them the knowledge of this and other customs existing at the time in eastern Asia. The appearance of a principle of land distribution resembling that of the old Teutons, among American tribes, cannot then be taken as proof that they were progressing and not degenerating, for it may, when our knowledge of ancient America becomes more accurate, be seen to be one of the lingering remains of an older civilisation which in a tropical climate favourable to indolence would easily decline. The religious beliefs and social customs of Asiatic and American races are in many respects so similar that there is abundant ground for questioning the originality of any civilised custom found among American tribes. Why should not comparative ethnology one day find the key to solve all such questions?

This fact, looked at from the eastern Asiatic point of view, is so far then from supporting the theory of progressive development, that it may rather be used as an additional buttress for the theory of degeneracy.

Names of number among Malayan and Polynesian tribes may be referred to as a proof of degeneracy. The sound "man" is 10,000 among the natives of Samoa and Tonga, as it is in Chinese, but it is 4,000 in the Sandwich islands, and 1,000 in New Zealand. Islanders avoid high numbers, and allow the significance of a name of high numbers to sink. This is proof of degradation. The reason why the arithmetical faculty among the New Zealanders has become weaker than elsewhere is because of their enormous distance from the continent of Asia. Samoa and Tonga are much nearer, and accordingly in those islands the religious traditions, *e.g.* circumcision, resemble those of Asia very closely. The Polynesians formerly had a decimal arithmetic, now it has sunk in Australia to quaternary or quinary arithmetic. In Ponape, one of the Caroline group, and comparatively near to the continent, *apuki* is 100 of men, trees, or yams, but 1,000 of eggs, cocoanuts, or stones. In Chinese *pak* is 100. After centuries of use high numbers fluctuate in value, because the intellect of islanders declines in power as the effect of long-continued isolation. The ideas, names, and usages of civilisation are gradually lost, and with them the human intellect becomes dwarfed.

Prof. F. Müller, after showing that the Polynesians could originally count to 100, adds, "Dies ist gewiss ein Zeugniss fur die nicht geringe geistige Begabung und frühzeitige Entwicklung dieser Volker." * The Polynesians, then, have sunk in power, and were, when visited by Capt. Cook, in a state of progressive degradation.

The question raised by Mr. Tylor was only—"Did Dr. Martius change his opinion about the degeneracy of Brazilian tribes?" Dr. Peschel thinks he did, but has not yet given sufficient proof. While I venture to think that the question—"Is savage man a degenerated being?" can be solved in the affirmative by the careful comparison of facts, without our needing to know that each scientific traveller holds this view, it would be most interesting to be assured that all such men are agreed upon it.

JOSEPH EDKINS

Disuse as a Reducing Cause in Species

IN a letter of mine (NATURE, vol. ix. p. 36), entitled "Natural Selection and Dysteleology," there occurs a footnote upon the above subject. As this footnote was rather carelessly written, I wish to explain my meaning more clearly.

In the first place, it is evident that the fact of disuse causing atrophy in individuals is no proof that it likewise causes atrophy in species; for if it does so, the laws under which it operates in the two cases must be quite different—the one set being as exclusively related to Inheritance, as the other set are independent of this principle. The primary question therefore is: Does inheritance here reproduce the character of immediate ancestors, as in congenital atrophy, &c.; or of distant ancestors, as in mutilations, &c.? I think there can be no reasonable question that it does the former, and so have no doubt that disuse is a cause of atrophy in species. The question as to degree, however, remains.

One sentence in the footnote I am explaining may be taken to imply that the effects of disuse are exhausted in a few generations. Nothing can be further from my meaning. If disuse acts at all in species, its *modus operandi*, as just stated, must be that of *causing* variations which are capable of being inherited; consequently, if disuse acts thus at all, it is impossible to assign limits to its operation in time. The question, however, is, In what proportion are the effects of disuse in the parents reproduced in the offspring? Variations caused by disuse certainly differ from congenital variations, in that they are not fully inherited; and it is the degree in which they are inherited that must determine the rate at which disuse here operates. This degree, however, is unknown: we only know that it is something very small. Now as disuse is in competition with other reducing causes, the rapidity of its action is an important factor in the estimation of its probable effects.

By the omission of the word "proportional" near the end of the footnote, I appear to institute an absolute comparison between the effects of disuse in wild and in tame species. This, of course, would be absurd. What I mean is, that supposing disuse to be the chief cause of atrophy in wild species, it has not produced so much effect in tame species as we should antecedently expect; for, although the facts are very scanty, so far as they go they tend to prove, that when an organ is disused for several generations only, the rate of its reduction is much greater than it ought to be, supposing disuse to be the main cause of atrophy in our domestic animals, and supposing the action of this cause to be uniform.

It will be asked, If we thus in part reject this cause, what other have we to substitute? This, of course, is a collateral issue; but as it is an important one, it may here be discussed. I would suggest the cessation of selection (see NATURE, vol. ix. p. 440) as a co-operating cause, for it seems to me that this *must* have acted here to some extent, and if no other causes have been at work, this extent must be the complement of the effects due to disuse. For the sake of definition, therefore, we shall assume disuse to be in abeyance. Now, on this assumption, we should expect to find that atrophy proceeds more rapidly during the initial stages of reduction than subsequently. But without dwelling upon this point, what may we infer from the existing degree of atrophy in the affected organs of our domestic animals? Supposing the cessation of selection to be the only cause at work, what degree of atrophy should we here expect to find? Before I turned to the valuable measurements given in the "Variation," I concluded (Cf. NATURE, vol. ix. p. 441) that from 20 to 25 per cent. is the maximum of reduction we should expect this unassisted principle to accomplish, in the case of natural as distinguished from artificially-bred organs. Now on calculating the average afforded by each of Mr. Darwin's tables, and then reducing the averages to parts of 100, I find that the highest average decrease is 16 per cent., and the lowest 5; the average of the averages being rather less than 12. Only four individual cases fall below 25 per cent., and of these two should be omitted (Cf. "Variations," p. 272). Thus, out of eighty-three examples, only two fall below the lowest average expected. Moreover, we should scarcely expect disuse alone to affect in so similar a degree such widely different tissues as are brain and muscle. The deformity of the sternum in fowls also points to the cessation of selection rather than to disuse. Further, the fact that several of our domestic animals have not varied at all is inexplicable upon the one supposition, while it affords no difficulty to the other. We have seen that disuse can only act by causing variations; and so we can see no reason why, if it acts upon a duck, it should not also act upon a goose. But the cessation of selection depends upon variations being supplied to it; and so, if from any reason a specific type does not vary, this principle cannot act. Why one type should vary, and another not, is a distinct question, the difficulty of which is embodied by the one supposition, and excluded by the other. For, to say that disuse has not acted upon type A, because of its inflexible constitution, while it has acted on a closely allied type B, because of its flexible constitution, is merely to insinuate that disuse having proved itself inadequate to cause reduction in the one case, it may not have been the efficient cause of reduction in the other. But the counter-supposition altogether excludes the idea of a casual connection, and so rests upon the more ultimate fact of differential variability, as not requiring to be explained. Lastly, it is remarkable that those animals which have not suffered reduction in any part of their bodies are likewise the animals which have not varied in any other way, and conversely; for as there is no observable connection between these two peculiarities, the fact of the intimate connection between them tends to show that special reduction depends upon general variability, rather than that special variability depends upon special reducing causes.

Dropping, however, our argumentative assumption, it will be remembered that I deem it in the last degree improbable that disuse should not have assisted in reducing the unused organs of our domestic animals; and the effect of this remark is to show that the cessation of selection is not able to accomplish so much reduction as I antecedently expected. On the other hand, it seems to me no less improbable that the cessation of selection should not have here operated to some extent; but in what degree the observable effects are to be attributed to this cause, and in what degree to disuse, I shall not pretend to suggest.

No doubt the above considerations are of a very vague description; but this only follows from the scarcity of the data at our disposal, and it is to this very scarcity that I am principally desirous of calling attention; for although it is with reluctant diffidence that I venture thus, even in part, to dispute the doctrine of one whom most of living men I venerate, yet, for the reason just given, I cannot help feeling that the time has not yet arrived for a final quantitative decision upon this subject. However, as before remarked, "the question thus raised is of no practical importance; since whether or not disuse is the principal *cause* of atrophy in species, there is no doubt that atrophy *accompanies* disuse."

GEORGE J. ROMANES

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* "Reise der Novara." Linguisticher Theil, 1867, p. 287.

Longevity of the Carp

LAST autumn, being at Fontainebleau, I was told by the servant of the Palace there that the German soldiers while in occupation of the place during the last war caught many of the carp in the pond of the Palace garden called "Jardin Anglais," and that some of these carp carried, attached by silver wire to their gills, little silver plates bearing inscriptions purporting that the plates were attached to the fish in the time of Francis I. and Henry II.—*i.e.* about 300 years ago.

Some of your German readers could easily ascertain by inquiry of the corps in occupation whether such fish were in fact caught. If it should turn out that they were, then, although the well-ascertained proof desired by Mr. Suffield (NATURE, vol. x. p. 147) would not of course be given, yet the fact would be evidence worth noting. F. G.

Cannes, June 28

THE "CHALLENGER" EXPEDITION *

V.

INACCESSIBLE AND NIGHTINGALE ISLANDS

THE first of these islands, the area of which is about four square miles, is situated about twenty-three miles W. by S. of Tristan d'Acunha. The cliffs rise to the height of about 1,000 feet in a perpendicular range on the north-east side. The tract beneath the cliffs is covered with *débris* of fallen rocks. On the cliffs themselves the plants are similar to those found in the same situation in Tristan. On the lower land are dense thickets of *Spartina arundinacea* Carm., a tall, reed-like grass, which here forms an extensive penguin rookery; patches of *Phylica arborea* Th. also grow on the summits of slight elevations; and under the shelter of the cliffs the trees attain a height of twenty feet, or even more. The trunks are seldom or never straight, but mostly lean over, or become partly procumbent, starting upright again towards the top. The largest trunk seen by Mr. Moseley measured a foot in diameter, but the trees on the upper plateau are said to measure 18 inches across, they do not, however, grow so high, being stunted by the force of the gales. The wood of the *Phylica*, though brittle, is said to be useful when properly dried, but in exposed situations it rapidly decays. Underneath the trees are ferns, mosses, and sedges, also *Acœna sanguisorbæ* Vahl., the leaves of which are used in New Zealand both as a tea and as a medicine. *Chenopodium tomentosum* Th., the tea-plant of Tristan, also grows in abundance, forming bushes with woody stems. A species of *Sphagnum*, *Carex insularis* Carm., and *Hydrocotyle capitata* Th. grew in a swamp near the penguin rookery. From the two Germans who were discovered on the island a good deal of information was obtained about the vegetation, more especially of that of the higher land, to which it was found impracticable to ascend from the side of the mountain where the ship anchored. The plants found there were similar to those which grew below, but in addition grew the species of *Empetrum*, found on the other islands, *Lomaria boryana* Willd., which in some instances attained a height of four feet, *Lycopodium insulare* Carm., and *Lagenophora commersonii* Cass., a small Composite plant with a daisy-like flower. The Tussock grass, which appears closely similar to *Dactylis cæspitosa* Forst., of the Falklands, grows in patches of considerable size on the upper plateau, and straggles up the cliffs to the summit. *Nertera depressa* Banks also grows on the plateau, and its berries form a favourite food of the *Nesocichla eremita*, the native thrush of the Tristan group; while the Bunting (*Emberiza brasiliensis*) feeds on the fruits of the *Phylica*.

The two Germans had cultivated the ground in the neighbourhood of their dwelling, growing potatoes, cabbages, and other European vegetables. Two species of clover also introduced by them were spreading rapidly, and a convolvulus was growing in quantity on the cultivated ground.

The other island of the Tristan group is named Nightingale Island, and is distant 20½ miles from Tristan d'Acunha, and 12 miles from Inaccessible Island. It is, comparatively speaking, a mere speck about one square mile in extent, and to the west are two small outlying islands covered with Tussock grass. A rocky peak 1,100 ft. high rises on the north side of Nightingale Island and is continued into a ridge stretching across the island, a valley separating this from a lower ridge which runs nearly at right angles. On the lower tract *Phylica arborea* occurs in patches, and on the high ground was seen *Lycopodium insulare* and a species of *Cotula* different from that found in Tristan and not seen at all in Inaccessible Island. *Sonchus oleraceus* L., which grows abundantly on the other islands, is, together with several other plants, absent from this. The Tussock grass forms a dense growth over nearly the whole island, growing in thick tufts or clumps to a height of five or six feet, and so matted together near the base of the clumps as to be almost impenetrable. The abundant growth of this grass causes the island to become an enormous penguin rookery, and the thick deposit of the excrement of the birds imparts a greater vigour to the plants, so that the lower parts or bases of the clumps become of a peaty character, beds several feet in thickness, of a black peaty richly-manured soil, being thus formed. It was with the greatest difficulty that a way was made through this thicket, the grass being too high to allow the planning of any definite track, and the screaming and biting of the penguins, together with the stench from the thick deposit of dung, being anything but agreeable. Indeed Mr. Moseley says that the specimens of Tussock grass which he gathered on Inaccessible and Nightingale Islands were lost in the continued fight with the penguins and the long grass. In one place a quantity of the trees of *Phylica arborea* had been blown down by the wind, and the trunks were lying dead on the ground. Lichens, as well as two fungi, were found on these dead trunks.

A dark green ulva forms a thin coat on the rocky shelves of the coast near the caves of the seals, which, when dry, as was the case during the *Challenger's* visit, has a peculiar metallic appearance. The island is never visited except during the sealing season.

Though it has been stated that the vegetation of the Tristan group knows no change of seasons, it is proved that some of the plants mentioned in these notes have their periods of flowering; thus the *Pelargonium* is said to flower in the middle of the summer, when a large number of the flowering plants are at their best, and the shore is covered with the fallen petals. At the time of the *Challenger's* visit in October few plants were in flower, but the phylica trees all bore fully developed green fruits.

From the geological as well as the botanical similarity of the three islands forming this interesting group, it may be surmised that a former connection existed between them. The different currents which sweep the Tristan group bring with them many foreign seeds, which are cast up on the shore. Amongst them was seen those of *Guilandina*, which are sometimes washed up on the Irish coast by the Atlantic current. These seeds are known in Tristan d'Acunha, as well as in Bermuda, where they are also occasionally cast up, as the sea-bean, the popular belief in the islands being that they are the seeds of a plant which grows at the bottom of the sea.

THE FIGURE OF THE EARTH IN RELATION TO GEOLOGICAL INQUIRY

THE elevation and depression of different parts of the surface of the earth above or below a mean ocean level has frequently formed the subject of communications to NATURE, but in no instance, as far as I am aware, have any of these changes been referred to the remarkable shape of the equatorial circumference of the earth, and to the changes which it is not improbable are constantly but slowly taking place in the position of the major and minor axes of the equatorial circumference. On p. 98 of the second edition of "The Heavens," by Amedée Guillemin, edited by J. Norman Lockyer, F.R.S., the following note is introduced in brackets by the editor :—

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* These Notes are founded on letters addressed to Dr. Hooker by Mr. H. N. Moseley. Continued from vol. ix. p. 486.

"The most recent results arrived at by geodesists have taught us that the earth is not quite truly represented by an orange, at all events, unless the orange be slightly squeezed, for the equatorial circumference is not a perfect circle, but an ellipse, the larger and shorter equatorial diameters being respectively 41,852,864 and 41,843,896 ft. That is to say, the equatorial diameter which pierces the earth from long. 14° 23′ east to 194° 23′ east of Greenwich is two miles longer than that at right angles to it."[*]

The history of these "results" may be briefly stated as follows :—

Capt. Clarke, R.E., in a communication to the Royal Astronomical Society, read April 6, 1860, and published in vol. xxix. of the "Memoirs," investigates the figure of the earth resulting from the best existing data. He concludes :—

"The result of our investigations then is this : that the ellipsoid which best represents the existing meridian measurements has its major (equatorial) axis in longitude 13° 58′·5 cast from Greenwich."

The greatest and least values of the meridian compression are—

$$\frac{a-c}{c} \quad . \quad . \quad . \quad . \quad \frac{1}{286\cdot779} \text{ in longitude } 13^\circ\ 58'\cdot5 \text{ E.}$$

$$\frac{b-c}{c} \quad . \quad . \quad . \quad . \quad \frac{1}{309\cdot364} \text{ in longitude } 103^\circ\ 58'\cdot5 \text{ E.}$$

and the length of the polar semi-axis, 20,853,768 ft. "The difference of the equatorial semi-axis is 5,308 ft., or, in round numbers, just one mile."

The investigation from which result the above figures was undertaken by Capt. Clarke, in consequence of remarks by the Astronomer Royal in the "Monthly Notices" of the Royal Astronomical Society, vol. xx. p. 104 (January 1860), on General Schubert's "Essai d'une détermination de la véritable figure de la terre." The results arrived at in General Schubert's memoir is that the earth is an ellipsoid, whose elements are—

Polar semi-axis	20,855,605 ft.	
Maximum compression . .	$\frac{1}{292\cdot109}$	
Minimum „ . .	$\frac{1}{302\cdot004}$	
Longitude of major axis of equator . . .	41° 4′	221° 4′
„ minor axis of equator . .	131° 4′	311° 4′

the longitudes being measured from Greenwich eastwards.

For the dimensions of the earth on the elliptic hypothesis, Capt. Clarke prefers the following values, given at p. 773, of the "Account of the Principal Triangulation (Ordnance Survey)," viz.—

$$\left.\begin{array}{ll} \text{Equatorial} \quad . \quad . & 20{,}926{,}348 \text{ ft.} \\ \text{Polar} \quad . \quad . & 20{,}855{,}233 \text{ ft.} \end{array}\right\} \text{Compression } \frac{1}{293\cdot76}$$

Mean degree . 364,613·33 ft.

The volume was published in 1858.

It appears, then, that somewhere between long. 13° and long. 41° east of Greenwich the major equatorial axis is about two miles longer at the present day than the equatorial axis at right angles to it; and during earlier geological epochs, when the crust of the earth was in a more plastic condition, these differences may have been considerably greater, and the effect on the geological structure of the earth intensified.

The point to which I wish to draw the attention of those who have studied the successive variations in the level of certain parts of the earth's surface, relates to the effect which this equatorial "bulge" must have produced upon various geological phenomena, and particularly if the longitude of the bulge varies according to a determinable law.

It will be readily seen that its influence will be felt—

1. On the elevation and depression of the land, especially near the equator.
2. On simultaneous elevation and depression on opposites sides of the earth.
3. On ocean currents, consequently on climate, &c.
4. On the thickening and thinning of formations to the east and west.
5. On the flow of rivers, hence on river and lake terraces, beaches, &c.

Observed facts, especially in North America, appear to show that the subsidence and subsequent elevation of that continent has always taken place very gradually and with a progressive motion from west to east and from east to west. In other words, these changes of level have assumed the form of a vast equatorial undulation progressing with extreme slowness, at one epoch in an easterly, and at another in a westerly, direction. This appears to be shown by the very gradual thinning out, or the very gradual thickening, of Tertiary, Cretaceous, and even Palæozoic formations. In Post-tertiary times, where we are brought nearer to the records of past changes, and may compare antipodal illustrations, it is apparently manifested by the stupendous escarpments which for 1,000 to 1,700 miles rear their wall-like fronts from 200 to 600 ft. above the Ontario, Red River, and Saskatchewan plains; and it is further indicated by the symmetrical river terraces and lake beaches which are developed to a very remarkable extent throughout the whole of the northern part of North America.

These occur both on the east and west flanks of the Rocky Mountains, and are found in the various passes *through* that great range. To enumerate examples would be to select any large river issuing from the Appalachian Chain, the Laurentides, or the Rocky Mountains, at elevations varying from 400 ft. to 4,000 ft. above the present level of the sea. I hope that some of your correspondents may supply illustrations of similar geological phenomena occurring as near as it may be possible to find records on opposite sides of the earth and during the same geological period of time.

To the supposed motion of the equatorial bulge may also be partly attributed the changes in the direction of the flow of certain rivers, and the elevation of an axis across the North American continent from east to west between lat. 35° and 45° N., by which the drainage of the great Canadian Lakes (excepting Ontario) was diverted from the Gulf of Mexico into the Gulf of St. Lawrence. The ancient river channels through which the great lakes sent their waters to the sea are now filled with drift to a depth varying from 200 ft. to 600 ft. During the period of depression the great lakes were in direct communication with the sea, and their waters were brackish or salt. The dredging operations which have been conducted in Lake Michigan show the former marine character of the fauna of the waters of this lake.

The origin of beaches and terraces appears to be intimately connected with an easterly or westerly progress of elevation simultaneously with a northerly and southerly elevation, such as would be produced by the slow movement of an equatorial bulge in an east or west direction. In North America, where terraces and beaches exist in perfection at altitudes varying, as already stated, from 400 ft. to 4,000 ft. above the ocean, the phenomena may be studied with some prospect of elucidation.

I have been credibly informed that data do not at present exist which would enable astronomers to state definitely that the bulge in the equatorial circumference of the earth between longitudes 13° and 41° east of Greenwich is stationary, or whether it has an easterly or westerly motion, and thus partakes of the character of an undulation. Perhaps, on consideration of the causes which produce this ellipsoidal form of the equatorial circumference of the earth, we may assume that the longitude of the major axis is constantly changing and progressing from west to east within certain limits, and then returning from east to west; in other words, oscillating through a determinable space.

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[*] Mem. R.A.S. vol xxix. 1860.

I have ventured to bring this interesting subject under the notice of the readers of NATURE in the hope that it may receive the attention which it appears to merit, and that satisfactory illustrations will be forthcoming to show that the differences between the equatorial major and minor axes of the earth are competent to explain or throw light on many disputed points in geological inquiry, and to lead to a rational solution of some difficult problems. On the other hand, it does not appear unreasonable to suppose that known geological facts may serve to point out a line of investigation which may lead to a more correct knowledge than we appear to possess at present of the figure of the earth, the probable changes which are slowly taking place, and the relation which these bear to geological inquiry.

HENRY Y. HIND

Windsor, Nova Scotia

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*REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL"**

V.

WHEN the investing bones, mentioned in the last paper, are removed, the chondro-cranium of the axolotl is seen to have a far lower structure than that of the salmon. The hinder part of the skull-floor is constituted by a flat plate of cartilage (Fig. 13, B.O) formed from the investing mass, and answering to the basi-occipital, but unossified. From this rises up on each side a narrow cartilaginous pedicle, which, uniting above with its fellow, forms the occipital ring inclosing the foramen magnum. An ossification—the exoccipital—is formed on each side of this arch where it bears the occipital condyles; but, as in all amphibia, the supra-occipital, like the basi-occipital region, remains cartilaginous.

From the front edge of the basilar plate proceed two cartilaginous rods, uniting between the nose capsules as an expanded inter-nasal plate (I.N) and rising up to form the walls of the brain-case, but leaving its floor and roof to be covered in by the investing bones—the parietals and frontals above and the para-sphenoid below. These rods are, clearly, the very slightly altered trabeculæ; they bear a single pair of ossifications, placed considerably in front of the optic foramen, and answering to the lateral elements of the "os en ceinture" or "girdle-bone" of the frog. The nasal capsules, situated immediately outside the expanded cornua trabeculæ (hypo-trabeculars), are as far apart as in the ray.

The auditory capsules are largely cartilaginous, but contain three bones—the prootic, the epiotic, and a small ossicle nearly filling up a membranous space in the capsule between the prootic and opisthotic regions; the space is the first appearance of a *fenestra ovalis*, the bone of a *stapes*, so that in the tailed Amphibians is seen the earliest foreshadowing of the delicate apparatus by means of which vibrations of the air are communicated to the membranous labyrinth. The apparatus is, however, in a very rudimentary condition, there being neither tympanic membrane nor external meatus, and the stapes being connected, not with a chain of ear-bones, but with a band of fibres, the stapedio-suspensorial ligament (s.s.l), which unite it with the hinder part of the suspensorium.

The upper end of the mandibular arch is not let down to a considerable distance from the skull like that of the salmon, but forms the whole of the suspensory apparatus of the lower jaw, thus taking on the function performed in the fish by the proximal portion of the hyoid arch. The suspensorium is a stout cartilage sloping downwards and forwards, rounded below into an articular surface for the jaw, and divided above into three processes, the pedicle (p) or true apex of the arch, the ascending process (a), and the otic process (o). The two former are coalesced with the hinder ends of the trabecula, the latter with the auditory capsule; the first division of the fifth nerve passes out between the pedicle and the ascending process. A granular deposit of calcific matter (Qu) in the lower part of the suspensorium is the only representative of the bony quadrate of the fish, the meta-pterygoid region remains wholly unossified.

The pterygo-palatine arcade is very rudimentary, being represented only by a thin bar of cartilage (Pl.Pt) passing forwards from the front edge of the suspensorium, but not coming into contact with the ethmoidal region. Two bones are, however, developed in connection with this cartilage—the small tooth-bearing palatine, and the enormous triangular pterygoid.

As in the salmon, the lower jaw, stripped of its investing bones, consists of an articular and Meckel's cartilage; the latter, however, is large and stout, and not reduced to a more slender root on the inner side of the dentary.

The hyoid apparatus (Fig. 12) is a strong bar of cartilage connected by ligament with the suspensorium and mandible; it is divided into cerato- and hypo-hyal, but is entirely unossified, and never comes into relation with the auditory capsule. The branchial arches are four in number; the two hinder are split up into a long epi-branchial, a short cerato-branchial, and a small wedge-shaped basi-branchial.

One of the most important points to be noted in the development of the skull is the formation of the stapes; this was formerly believed to be the apex of the hyoid arch, but its true nature—as a separated portion of the wall of the ear capsule—has been demonstrated in the frog, and confirmed in the newt, axolotl, and other forms. In the axolotl of about an inch long a crescentic slit is seen in the auditory capsule, formed by the degeneration of its cartilage into fibrous tissue; the ends of this slit extend and meet, and thus cut off a circular plug of cartilage set in a ring of fibre, producing at once the stapes and the fenestra ovalis.

The investing mass remains long in the condition of indifferent tissue, and even after chondrification has set in the two halves remain separate until a very late period, thus approximating to the state of things found in Menobranchus and Proteus, in which the two parachordals are permanently united only by fibre.

The trabeculæ are at first parallel with the post-oral arches, and only at a comparatively advanced stage come to lie almost at right angles to them, as in the first stage of the salmon. The pterygo-palatine process is very late in its development, arising as a bud from the mandibular arch, and growing forwards towards the trabeculæ, with which, however, it never actually unites. The minor changes which the arches undergo will not be described here, as they have been worked out at far greater length in the frog.

VI. *Skull of the Frog* (Rana temporaria).—As far as its general aspect is concerned, the skull of this well-known Batrachian is by no means unlike that of the axolotl: it presents, however, many important differences, and shows a marked advance towards the sauropsidan and mammalian type.

Among the most important of these characters may be mentioned the backward slope of the suspensorium (see Fig. 14), the large size of the maxilla and its connection, through the intermediation of a small separate bone (the quadrato-jugal, Q.Ju), with the quadrate, the union of the palato-pterygoid cartilage with the ethmoidal region, the disappearance in adult life of the branchial arches, and, most important of all, the separation of the upper end of the hyoid arch as a chain of auditory ossicles, for the purpose of communicating the vibration of the tympanic membrane to the stapes.

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* Continued from p. 108.

Certain noteworthy peculiarities may be mentioned, with regard to the investing bones, the chief being the fusion of the parietal and frontal into a single bone (Fr.Pa), the dagger-like form of the para-sphenoid, and the addition of a horizontal bar to the upper end of the squamosal which seems to answer to one of the bony plates developed in ganoids in the temporal region, while the vertical portion is clearly the homologue of the pre-opercular. An extremely small membrane-bone is also developed in connection with the external nasal opening: this is the septo-maxillary (S.Mx), which is interesting from its reappearance in lizards, snakes, and birds.

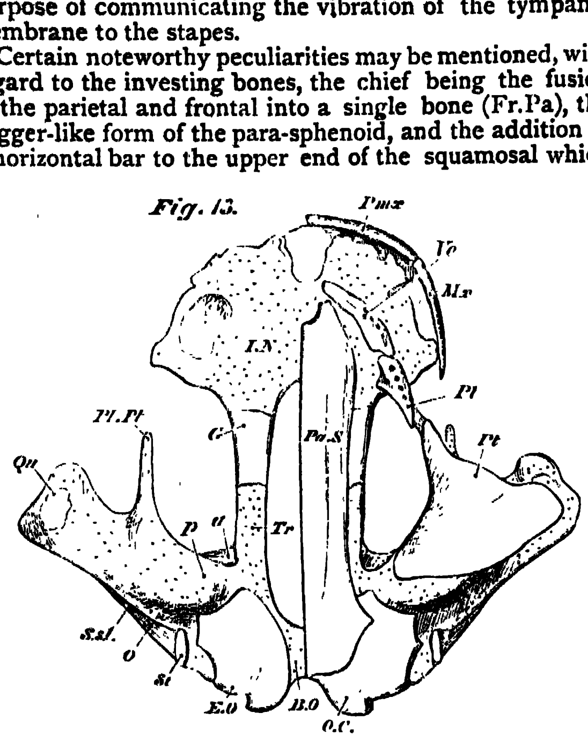

FIG. 13.—Skull of fully adult Axolotl, under view (× 2 diam.), the investing bones being removed from the right side. I.N, inter-nasal plate; p, pedicle, a, ascending process, and o, otic process of the suspensorium.

In the cartilaginous brain-case the form of the trabeculæ is entirely lost by the complete union of those arches below, so as to form a solid floor of cartilage within the para-sphenoid, and by the formation of a roof of like character beneath the fronto-parietals: the latter is interrupted by a large anterior and a pair of small posterior fontanelles. Just behind the inter-nasal plate a stout dice-box-shaped ossification is developed (G) overlaid above by the frontals and below by the para-sphenoid; this is the girdle-bone ("os en ceinture" of Cuvier), and answers to the hinder part of the ethmoid, the fore part of the pre- and orbito-sphenoids, and the pre-frontals. In its posterior half this bone contains a single cavity, in which are lodged the olfactory lobes of the brain, but in its anterior moiety a vertical partition (mesethmoid) divides it into two chambers, through which the nerves of smell pass to the nasal sacs.

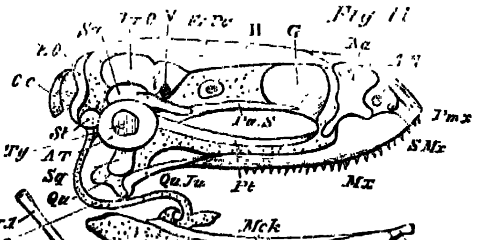

FIG. 14.—Skull of Common Frog (× 2). Ty, tympanic membrane; A.T, annulus tympanicus; M.Mck, mento-meckelian.

Only a single bone occurs in the auditory capsule—the prootic, which extends backwards, so as almost to meet the exoccipital; the opisthotic, epiotic, and stapes remain entirely cartilaginous.

The palatine (Fig. 15, Pl) is a slender bone not provided with teeth; the pterygoid is 3-ranged, having an anterior process coming into relation with the palatine, a posterior articulating with the auditory capsule, and a descending bar which runs along the inner side of the suspensorial cartilage; the two latter help to inclose the eustachian opening (Eu). The suspensorium does not present that clear division into pedicle, ascending process, and otic process which is observable in the axolotl; the second of these is, in fact, represented only by fibrous tissue, while the pedicle and the otic process are completely fused with the auditory capsule.

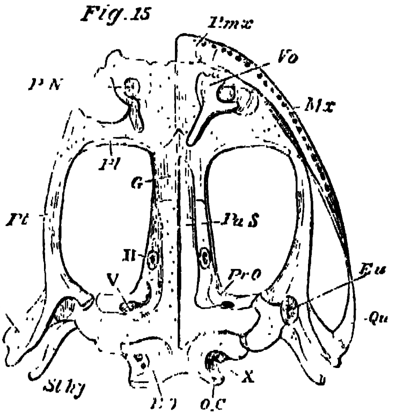

FIG. 15.—Skull of Frog, under view (× 2), the investing bones removed from the right side. P.N, posterior nares; Eu, aperture of eustachian tube.

There is no articular bone in the mandible, but an interesting ossification (M.Mck) of Meckel's cartilage takes place at the point of union of the two rami. This is the symphysial ossification or "mento-meckelian" bone; it has been found in the sturgeon and also in early stages of the human subject.

The hyoid arch is divided into two portions, an upper, which subserves the function of hearing, and a lower, which supports the tongue. The first of these (Fig. 16) is a hammer-shaped apparatus, partly cartilaginous, and partly bony, the handle of which articulates with the stapes (St), while the head is fitted into the drum-membrane (Fig. 14, Ty).* The parts of this ossiculum auditûs have been named by Prof. Huxley, in their relation to the stapes, inter-, medio-, extra-, and supra-stapedial; taken together they answer to the hyo-mandibular and symplectic of a fish. The medio-stapedial (M.St) is ossified; the other portions of the apparatus are cartilaginous. The tongue-cartilage is a shield-shaped plate consisting of basi-hyal in its anterior and basi-branchial in its posterior part, and connected with the skull by two slender, spring-like rods, the stylo-hyals (St.Hy), which are fused with the auditory capsule; these answer to the anterior or lesser horns of the hyoid bone of man, the greater horns being represented by the ossified first hypo-branchials or thyro-hyals (H.Br. 1) which embrace the larynx.

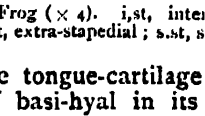

FIG. 16.—Ear-bones of Frog (× 4). i.st, inter-stapedial; m.st, medio-stapedial; e.st, extra-stapedial; s.st, supra-stapedial.

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* The annulus tympanicus (A.T), or ring of cartilage which supports the drum-membrane, would seem to answer rather to the external ear of a mammal than to the tympanic bone.

FERTILISATION OF PAPILIONACEOUS FLOWERS—CORONILLA

IN NATURE, vol. vi. pp. 478 and 498, you inserted a paper of mine in which an attempt was made to draw certain general conclusions concerning the fertilisation of papilionaceous flowers from the examination of a few genera, chiefly English: and in that paper I stated that the foreign genus *Coronilla* presented peculiar difficulties. I have since then been stimulated by Mr. Darwin's kind interest to examine *Coronilla* more carefully, and now send you the results.

The ultimate result of these generalisations was that in all the following particulars, viz. the position and motion of the flowers and the peduncle, the cohesion of the petals, the cohesion of the stamens (so remarkable a feature in this tribe); the structure and character of the filaments, of the anthers, and of the pollen, the structure of the style and stigma; and the place where nectar is secreted; the parts and functions are so organised and correlated as to induce and compel insects, generally bees, in visiting the flowers for nectar, to carry away with them pollen from one flower and bear it to another.

One, perhaps the most striking, of the generalisations in question was as follows:—

"The degree to which the cohesion of the stamens is carried, so remarkable a feature in this tribe, seems to depend on the necessity for access to nectar. In those flowers in which the stamens are monadelphous, viz. Ulex, Sarathaumus, Genista, Cytisus, Ononis, Lupin, there is no symptom of nectar within the staminal tube, no space for it, and no access to the interior. In some, at any rate, of these, viz. Ulex, Ononis, and Lupin, the bees certainly resort to other parts of the flower. On the other hand, where the tenth stamen is entirely free or where it is separated from the others at the base, so as to give an insect access to the interior of the staminal tube, there is nectar within this cavity."

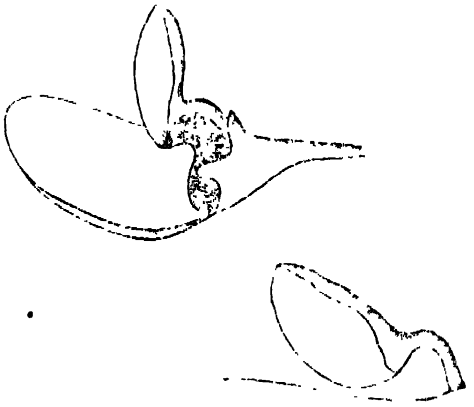

FIG. 1.—Coronilla varia.

To this generalisation the two species of *Coronilla* which I had examined, viz. *C. varia* and *C. glauca*, seemed to form an exception. In them the tenth stamen was always separate; but there was no aperture at the base of the staminal tube, no nectar within the staminal tube, and no space for it, the base of the staminal tube fitting as closely round the pistil as it does in those papilionaceous flowers in which the tenth stamen is not separated from the rest.

I have since had an opportunity of examining several species of *Coronilla*, and of watching large plants of *C. varia* (Fig. 1) and *C. emerus* (Fig. 2) in full flower. In all these flowers there is a peculiar structure of the petals. The claw of the vexillum is thin, sometimes prolonged and straight as in *C. emerus;* sometimes shorter and curved as in *C. varia.* The claws of the other petals cohere so as to form a channel, in which the staminal tube lies. But in all cases there is, immediately above the calyx, a large open space between the claw of the vexillum and the claws of the other petals so as to have free access from the outside to the inside or the inside to the outside of the flower.

One hot day last August I watched a bee rifling the flowers of *C. varia* in the regular way. He settled as usual on the lower flowers of the crowded umbel first, resting on the wings and keel, and went rapidly round and up the umbel. The plant was a large one, and he must have been there more than half an hour. He did not seem to be taking pollen. What could he be doing? for there was no semblance of nectar either inside the base of the petals or calyx or inside the staminal tube. On examining the flower carefully with a glass the *outside* of the calyx, which is thick and fleshy, appeared to be covered with shining glands or vessels, sometimes I think moist, but always yielding copious liquid on very slight pressure. Could this be what the bee was seeking? On a subsequent day I again watched a similar bee rifling the flowers, and at last distinctly saw his proboscis, which had entered as usual by the front of the flower, protruded outwards through the gap between the claws of the petals and sweep the outside of the calyx. Here then was an answer to my difficulty. The nectar for which the bee sought the flower, and in getting which he benefited the plant by carrying pollen from flower to flower, was not in any of the usual places inside the flower, but outside the calyx, while there was a very peculiar construction of the petals giving access to it. Instead of proving an anomalous exception to the generalisations I have quoted above, it turns out to be another curious illustration of the various ways in which the same function of secreting nectar and of attracting the bee to it in the manner requisite for fertilising the flower is effected by different organs. That the outside of the calyx should secrete nectar and that there should be a peculiar window, out of which the bee, having entered by the regular door, and having in so doing dusted himself with pollen, should be able to get at the nectar, is surely a remarkable specialisation, and also a remarkable confirmation of the result of generalisations I had previously made.

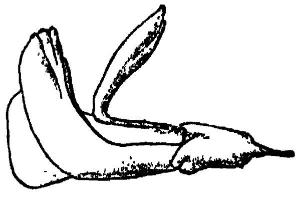

FIG. 2.—Coronilla emerus.

Since then I have examined some other species or varieties of *Coronilla*, viz. *Coronilla emerus*, a very pretty free flowering garden shrub or creeper, a variety of this named *Coronilla emerus lutescens*, *C. montana*, and *C. minima.*

In *Coronilla emerus* the claws of the petals are much prolonged, so as to make the whole flower much longer than in the other species (see Fig. 2). The structure of the staminal tube is like that of Pisum, Lathyrus, Robinia, &c., in having a large cavity at the base filled with water, and large apertures on each side of the base of the tenth stamen, by which the bee's proboscis can reach the nectar. The long tube or channel formed by the claws of the petals is such as to lead the bee's proboscis directly to these apertures; and I have this spring distinctly seen a humble-bee getting the nectar in this way. The aperture between the claws enabled me to see the bee's proboscis going right down to the base of the staminal tube. On the other hand there is no appearance whatever of nectar or of glands containing nectar outside the calyx.

In *C. emerus lutescens* the structure is the same, except that there is a curious little excrescence on the inside of the claw of the vexillum just above the calyx. Does it guide the bee's proboscis to the apertures in the staminal tube, which it is to be remembered are on each side of the central tenth stamen? Mr. F. Darwin has suggested a function of this kind for a somewhat similar structure on the free tenth stamen of Phaseolus.

C. montana is a small plant, very like *C. glauca* in structure. The flower forms compact umbels; the claws of the petals are short, with a wide opening above the calyx; the tenth stamen is free, but the staminal tube is close-fitting, and there is no nectar inside the flower. *Per contra*, there are distinct glands or bubbles of liquid on the outside of the calyx, which is much infested by aphis.

C. minima is similar in structure; and both these species or varieties are similar to *C. glauca*.

We have then in this genus a number of species or varieties, all of which have their tenth stamen free, but which differ widely in other respects.

1. In *C. emerus* and *C. emerus lutescens* the nectar is in the base of the staminal tube, and is accessible by the separation of the tenth stamen in the usual manner.

2. In *C. varia*, *C. montana*, *C. glauca*, and *C. minima* the staminal tube is barren of nectar, but the nectar is secreted outside the calyx, and the access to it is provided for by a special gap between the petals.

In both cases, however, the flower is so constructed that the bee in getting the nectar which he wants dusts himself with and carries from flower to flower the pollen.

Some questions remain. The separation of the tenth stamen and the gap between the petals and the separate stamen both exist in all the species; where one is of use the other is useless. Why do they co-exist? Did one exist before the other? and is one of them now useless and rudimentary? If so which was the earlier and which the later in development?

A further observation arises. These *Coronillas* are foreign plants, and in many gardens and greenhouses have only been introduced recently. In my own garden in Surrey I have introduced *C. varia* and *C. emerus* from London within these last four years, and I am not aware of any other plants in the neighbourhood. But the bees seem quite to understand how to get the nectar from both. In *C. emerus* this is not surprising, for there are many other common flowers—Robinia, Pisum, Vicia, Lathyrus, &c.—similarly constructed. But I know of no flower common in England which is like *C. varia* in having the nectar outside the calyx, with the peculiar access to it through a gap in the petals. And yet the Surrey bee found his way to it at once. Does not this look as if the bee had sufficient intelligence to adapt his doings to a perfectly new and unknown structure?

T. H. FARRER

LENZ'S DOCTRINE OF OCEAN CIRCULATION

A VERY elaborate memoir was presented to the Royal Society at its last meeting, by Mr. Prestwich, containing a digest of all the observations made upon deep-sea temperatures previously to the *Lightning* cruise of 1868, which was the starting-point of all those recent researches that have excited so strong and general an interest. Of these observations, some of the most important were quite unknown to the scientific men of the present day, until brought to light by Mr. Prestwich's patient research; and I would take the earliest opportunity of particularly calling attention to those of Emil. Lenz, an eminent German physicist, formerly settled in St. Petersburg,[*] who accompanied Kotzebue in his second Circumnavigation Voyage in 1823–26. Of this voyage, the obtaining of deep-sea temperatures was one of the special objects; and, with a view to accuracy of observation, experiments were previously instituted by Parrot upon the influence of pressure on self-registering thermometers, of the same kind as those made by Mr. Casella under the late Prof. W. A. Miller and myself in 1869. And the St. Petersburg professors satisfied themselves by their experiments (as we did by ours nearly fifty years later), that any observations taken by sending down ordinary thermometers to great depths must be seriously vitiated by the pressure of the superincumbent water.

Instead of attempting, however, to improve his thermometers by the protecting outer bulb[*] which made our instruments thoroughly trustworthy, Lenz devised a method of obtaining deep-sea temperatures, which must have been very difficult to work, and which required a good deal of mathematical computation to bring out its results; yet this in his able hands gave temperatures which prove to be in close accordance with the thermometric observations of the *Challenger*. He also made throughout the voyage a careful series of observations on the temperature of the ocean at the surface and at moderate depths below it, which proved to be of the greatest value in the establishment of his general doctrine. And he further made an important series of observations on the salinity of ocean-water as indicated by its specific gravity. The increase of the density of sea-water with the reduction of its temperature down to the freezing-point, was known to Lenz through the experiments of Dr. Marcet in this country, and of Erman in St. Petersburg; and he was consequently free from the influence of the "dominant idea" that the deep water of the ocean, like that of the Swiss lakes, would have the uniform temperature (39½° F.) of *fresh* water at its greatest density; which obviously influenced the conclusions subsequently drawn from their own observations by D'Urville and Sir James Ross, and led to the general adoption of those conclusions.

The whole series of these observations, with the mathematical computations required for the determination of the real bottom-temperatures, are contained in a most elaborate memoir, entitled "Physikalische Beobachtungen, angestellt auf einer Reise um die Welt, unter dem Commando des Capitains von Kotzebue, in den Jahren 1823-26," presented to the St. Petersburg Academy in 1829, and published in vol. i. of its "Transactions" (1831). No one can examine this memoir without being impressed with the remarkable ability it displays; a peculiarly competent judge, Prof. Debus, whose attention I have directed to it, assures me that it is a model of admirable physico-mathematical investigation.

It was not until 1845, however, that Lenz gave forth the general conclusions to which he was led by his own observations and those of others (so far as known to him) in his admirable "Bemerkungen über die Temperatur des Weltmeeres in verschiedenen Tiefen," published in the "Bulletin" of the St. Petersburg Academy for 1847. He there shows that his own conclusions as to the low temperatures obtained at great depths are not invalidated by the observations of others, indicative of higher temperatures taken with ordinary thermometers; but may still be taken as indicating the presence of glacial water on the bottom of each of the great oceans, even under the equator. And from a discussion of the numerous temperature-observations taken at the surface and at small depths beneath it, Lenz deduces the important conclusion *that there is at and under the equator a belt of water cooler than the water to the north and south of it.* Of this striking phenomenon, he says, the explanation flows directly from the form of the isothermal curve which represents it; and this explanation I shall presently reproduce in his own terms, which will be found singularly accordant with those used by myself in the notice I gave of the *Challenger* observations in the *Athenæum* of May 16.

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[*] The list of Lenz's papers occupies four columns of the Royal Society's Catalogue. A large proportion of them consist of original researches, both experimental and mathematical, in electricity and magnetism. And I am assured by Sir Charles Wheatstone that these are of the highest merit, and were greatly esteemed by Gauss and Jacobi, the two great masters in this department of investigation.

[*] It is right to recall the fact that this "protection" was first devised by Admiral Fitzroy, and was practically worked out by Messrs. Negretti and Zambra, as far back as 1857.

As I have never claimed any originality in regard to the doctrine of oceanic circulation, which I have advocated solely as an important scientific truth, it has afforded me nothing but the most unalloyed satisfaction to find that the doctrine which appeared to me, as to Sir John Herschel (when I brought the case fully before him), the "common sense of the matter," was put forward nearly thirty years ago by one of the most eminent physicists of his day, as a necessary deduction from the facts of observation. That Lenz's Doctrine of Oceanic Circulation (for so it should now be termed) did not then obtain the general acceptance which I now confidently anticipate for it, seems principally due to the little attention formerly paid to Ocean Physics; it being only in recent years that the relation of deep-sea temperatures to the distribution of animal life on the ocean bottom, and the consequent importance of this knowledge in geological research, has made the inquiry one of general interest. This is the point of view in which the study of the subject has been pursued by Mr. Prestwich, whose exhaustive memoir will constitute a most valuable preface to the full discussion of the *Challenger* observations, when these shall have been brought to a conclusion two or three years hence.

"The mass of water in the tropics," says Lenz, "warmed down to a certain depth by the sun's heat, cannot maintain its equilibrium with the colder water of the middle and higher latitudes; a flow of the warmer water from the equator to the poles must necessarily take place on the surface, and this surface-flow must be supplied at the equator by a flow of colder water from high latitudes, which would at first flow in an almost horizontal direction, but which under the equator must rise from below to the surface. In this manner, in the northern hemisphere, a great vertical circulation takes place in the ocean, which has its direction above from the equator to the pole, and below from the pole to the equator. Since these flows, moving in opposite directions, are distinguished by their different temperatures, we observe in the submarine isotherm an indication of the lower portion of this flow. A corresponding flow, but moving in the opposite direction, takes place in the southern hemisphere; so that *in a zone surrounding the equator, where the two flows meet, the water flows almost in the direction from below up to the surface*."

Lenz further adduced the low salinity of the surface-water of the equatorial belt, compared with the high salinity of tropical water, as an additional indication of the continual ascent of polar water from the bottom. And after remarking that water moving in the north and south direction must have its course influenced by the rotation of the earth, he continues, "It is a point which has been determined by Humboldt, John Davy, and others, that the water of the ocean is colder at the surface over shallows, than at some distance beneath over very great depths. This phenomenon, the explanation of which hitherto has not been found to be satisfactory, is a simple consequence of the movement of deep cold water from the pole to the equator. For if this runs against any obstruction, such as a shallow would present, it will rise along it, as upon an inclined plane, and approach nearer the surface, which in this manner will be cooled down." Thus Lenz explicitly propounded the principle on which I have explained the "cold band" between the Gulf Stream and the United States sea-board, the similar cold band on the east coast of Japan, and the cold stratum on the east side of the Dogger Bank. And I venture to believe, therefore, that here, too, the "common sense of the matter" has led me to a right conclusion.

I learn also, from Mr. Prestwich's memoir, that Arago, in 1838, in his instructions for a scientific expedition to Africa, not only distinctly recognised the existence of an underflow of glacial water from the poles towards the equator as the cause of the reduction of oceanic temperature with depth, and explicitly repudiated the doctrine of the uniform deep-sea temperature of 39½°; but also remarked upon the comparatively high temperature of the deeper stratum of the Mediterranean (first ascertained by D'Urville) as indicating that the polar flow does not find its way into that basin through the Strait of Gibraltar; thus anticipating the argument which I have based on my own investigations into the comparative thermal conditions of the Atlantic and the Mediterranean, as to the existence of a polar underflow in the former.

WILLIAM B. CARPENTER

NOTES

WE greatly regret to announce that Prof. Ångström died on the 21st ult.

MR. JOSEPH PRESTWICH, F.R.S., F.G.S., has been appointed to the office of Professor of Geology in the University of Oxford, as successor to the late Prof. Phillips.

THE Chair of Human Physiology in University College, London, in future to be called the Jodrell Professorship, after the name of its endower, has been filled by the appointment of Dr. J. Burdon Sanderson, F.R.S., who is now Professor of Physiology, including Practical Physiology and Histology. We have reason to believe that Mr. E. A. Schäfer will be appointed Assistant Professor under Dr. Sanderson.

M. A. DE CANDOLLE has been elected a Foreign Associate of the French Academy in the place of the late Prof. Agassiz.

THE death, at the early age of 28, is announced of Mr Charles Tyrwhitt Drake, one of the officers in charge of the survey of Palestine. He succumbed to a second attack of malarious fever.

ENTOMOLOGISTS generally, and Coleopterists in particular, have experienced a great loss in the death of Mr. George Robert Crotch, M.A., of St. John's College, Cambridge. Mr. Crotch graduated in 1863, obtaining honours in the Natural Science Tripos. Until 1872 he was one of the Under Librarians at the University Library, when, besides his excellent work in that Institution, he devoted his spare time to his favourite subject. Mr. Crotch sailed for America in 1872, *en route* for Australia, for the purpose of studying the entomology of parts which he considered incompletely known, and on several occasions he has transmitted collections to England. He had added considerably to our knowledge of the entomology of California, Vancouver's Island, Oregon, and other districts; and on two occasions the Senate of Cambridge, recognising the importance of his work, voted him a sum of money from the University chest to aid him in sending collections to the University Museum.

TWO scientific expeditions are to set out from Archangel next summer—one into Russian Lapland, for the purpose of exploring the traces of ancient glaciers; the other, to the shores of the White Sea, has for its object zoological investigations. Dr. Yarjinsky, *La Revue Scientifique* states, who explored the district two years ago, discovered in the White Sea and the glacial ocean fishes and crustaceans till then quite unknown.

MR. JAMES LICK, of San Francisco, California, having in the course of his life accumulated a large fortune, has recently concluded a deed by which he conveys all his property to seven persons upon trust to be applied to various worthy objects. Among these, 700,000 dols. are to be applied to the construction of a more powerful telescope than any yet made, to be erected at an observatory in California, and 300,000 dols. to found, in California, a school of the mechanical arts.

THE last but one of the Government expeditions for observing the transit of Venus sailed from Plymouth for Christchurch, New Zealand, in the clipper ship *Merope*, on Saturday. The party consists of Major H. S. Palmer, R.E., chief astronomer in charge; Lieut. L. Darwin, R.E., assistant-astronomer and photographer; Lieut. H. Crawford, R.N., assistant-astronomer, and three non-commissioned officers of the Royal Engineers trained in the use of the photoheliograph.

A CORRESPONDENT writes that he has tried, with almost complete success, Prof. Helmholtz's remedy for Hay Fever, referred to in the paper (NATURE, vol. x. p. 26) sent us by Prof. Tyndall. Our correspondent gives the details of his treatment in a letter to the *Manchester Examiner* of the 30th ult., which also contains a letter from another sufferer who has tried Helmholtz's remedy with success. Our correspondent also asks,—"Could any of your readers give any information as to Weber's nose douche?—a more effective method of administering the remedy than by means of the pipette is desirable."

MR. SAVILLE KENT, Curator of the Manchester Aquarium, seems resolved to do his best to make that institution subserve the purposes of scientific instruction. Last Friday he gave the first of a series of lectures on subjects connected with aquaria to a fairly numerous audience; it is intended, we believe to continue the lectures on Friday afternoons during the summer.

DR. JOHN KIRK has received a letter from Lieut. Cameron dated Ujiji, Feb. 25, reporting his safe arrival at that place; he was just about to start for Unyanyembe. He heard from the people of Ujiji that the Lualaba from Nyangwé goes into the Mwootawzige or Bahari Unyoro, "so that," he says, "it must be the Nile after all."

MR. FORSYTH, the leader of the Yarkund Mission, arrived at Leh on the 17th. ult. He is expected in Calcutta about the 15th inst. Dr. Stoliczka is reported to have died on the 19th ult. at Shyok, above the Saser Pass.

THE prospectus is issued of a series of Positivist publications, *La Bibliothèque Positiviste*, to be written by M. André Poëy, having for its object the popularisation of the positive philosophy. The prospectus is mainly an eloquent eulogy of the Positivist doctrines, and an attempt to show that since Comte began to write they have gradually penetrated everywhere. The *Bibliothèque Positiviste* will consist of 30 monographs, to be published at intervals, in which the principles of Positivism will be expounded in relation to every sphere of human thought and action. The first part is entitled "La Bibliographie Positiviste," and will contain a list of 750 publications in favour of or opposed to Positivism, all of which have been published since Comte began to write. The publisher is Ernest Leroux of Paris.

THE Turners' Company, unlike most of the antiquated City guilds, seems to be alive to the fact that there are other kinds of merit worthy of honour besides the distinguished one of being a prince of the blood, a foreign potentate, a conquering hero, or one of her Majesty's ministers. It requires distinction of a very blazing kind indeed to attract the attention of most of our obtuse City Companies. The above Company is, however, a creditable exception in this respect to most of the others. Shortly before his death it conferred its freedom upon the late Prof. Phillips, and last week it did itself the honour of marking in a similar way its appreciation of the work which has been done by Sir Charles Lyell, Bart., F.R.S. The Turners' Company is evidently awake to the fact that after all the Useful Arts, Manufacture, and Commerce may derive some benefit from the results of non-utilitarian scientific research. The arts represented by the Turners' Company use, as part of their material, various sorts of stones, and Mr. Jones, the Master, showed in his really eloquent and well-informed address last week, that these arts have been greatly indebted to Sir Charles Lyell for having done much in their behalf by spreading a knowledge of the materials with which they work. Sir Charles, in his reply, spoke of the storm of opposition raised against many of the geological doctrines propounded in his first work, half a century ago, as compared with their almost universal acceptance at the present day.

WE have received a copy of a very able address delivered by Dr. Julius Haast, F.R.S., before the Philosophical Institute of Canterbury, New Zealand, in which he comments on several points connected with the geology of that country, maintaining his own theory as to the glacial origin of the Canterbury Plains in opposition to that of their marine formation, as supported by Capt. Hutton. In speaking of the extinct Struthious birds whose remains are so abundant, he is disposed to divide them, contrary to Prof. Owen, into two main families: the Dinornithidæ with a long metatarsus, no hallux, and a bony scapulo-coracoid bone; and the Palapterygidæ with a short metatarsus, with a fully-developed hallux, and no ossified scapulo-coracoid bone; the last-named character being one of particular interest, and supported by several arguments, the strongest of which depends on the absence of any coracoid articular grooves on the anterior margin of the sternum.

A RATHER strong shock of earthquake was felt at Constantinople on Friday, lasting two seconds. No accident is reported.

THE French Government has recently voted the sum necessary for the formation of a great inland sea in Algeria, 190 miles long by 36 broad, to the south of Biskra. A chain of chotts (*Chott* implying the bed of a lagoon) considerably below the level of the Mediterranean, is to be utilised for the purpose. A full account of the project is given in the first June number of the *Revue des Deux Mondes*.

THE meeting which was to have been held this month in London in connection with the Edinburgh University Buildings Extension Fund, has been postponed until November next.

MR. SANDERSON, from Lancing College, has been elected to a Natural Science Scholarship in Worcester College, Oxford. Messrs. Hugh Brocas-Price, from University College, London, and Mr. Henry H. Robinson, from Magdalen College School, have been elected to Natural Science Demyships in Magdalen College.

MR. W. J. NOBLE, of Epsom College, has been elected to a Natural Science Scholarship in Keble College, Oxford.

A MEANS of preventing the spread of the vine-pest, the *Phylloxera vastatrix*, is said to have been found, in the spreading of a layer of fine sand on the ground round the stems of the plants. The sand is said to be too loose for this insect to pass through, and the consequence is that it is intercepted in its passage from one plant to another. We are sorry to hear a report that this plague has found its way into Australia. The vine-growing districts of our Australian colonies are becoming so important that we trust this report may be unfounded. At all event steps should be taken to prevent its introduction into any of our colonies: such a measure will be easier than its destruction, should it ever gain a footing in them.

IN view of the scarcity and high price of oysters in this country it is alarming to hear that the celebrated beds of Arcachon, Concarneau, and other places in the west of France, are thought to be less productive than formerly. The want of accurate knowledge concerning this bivalve is probably at the root of this scarcity, and it may also be possible that the changes which are constantly taking place in the position and even in the nature of the sea-coast, may have a serious effect on the productiveness of the oyster beds all over the world. It is a well-known fact that oysters will not grow in certain localities where the conditions are apparently exactly similar to other localities where they will thrive; and the gradual change wrought by the sea in certain parts of the coast may account, quite as much as overfishing, for the gradual extinction of oysters. All beds are, however, fished much more extensively now than they were a few years ago, and whenever one is discovered, it is quickly worked out, without any consideration being given to the question of its extent, and whether it is a newly-established bed or not. America now largely supplies us with oysters either in a fresh state or preserved in tins, and it is calculated that in Maryland State alone, 5,282 persons are employed in dredging, and 10,947,803 bushels of oysters were taken in 1870-71; while the waters of Virginia are said to be equally productive. In the great oyster markets of Baltimore, where immense quantities of oysters are tinned, over 10,000 hands are employed in this branch of the trade.

A VALUABLE contribution to zoology is furnished by a paper published by Mr. Dall, on the birds of the Aleutian Islands, especially of that portion of the region to the west of Oonalaska, embracing the result of observations made during 1873 on board the U.S. Coast Survey vessel, the *Yukon*. As might have been expected, the great majority of the species are water-birds, particularly *alcadæ*, upon the natural history of which Mr. Dall throws much light, having been the first to collect eggs of several of the species, and observe their habits during the breeding season. The land-birds on this island are very few in number, consisting of two kinds of hawks, one owl, a swallow, and a wren, five finches, the raven, and ptarmigan. The total number of species enumerated is forty-five.

WE have received the prospectus of a work entitled "The Dominion of Canada; comprehending a General Description of the Confederated Provinces of British North America, and the North-west Territories," by Henry Youle Hind, M.A. (Montreal: John Lovell.) The following are the leading subjects:—I. Physical Geography of the Dominion. II. Climate and Climatic Effects. III. Geological Features. IV. Travel and Transportation. V. Agricultural, Forest and Mining Industries. VI. Commerce, Manufactures, and Fisheries. VII. The Inhabitants. VIII. Government. IX. Social Status. X. Miscellanea. The illustrations will consist of upwards of 250 engravings on steel, chromoxylographs, woodcuts, &c.

AT present the principal source of income to the United States from its acquisition of Alaska, and that which pays the larger part of the interest on the original investment of 7,000,000 dols. in its purchase, is derived from the fur-seal islands of St. Paul and St. George, which constitute the Pribylov group, in the Behring Sea. It is from these islands that the greater number of the skins of the fur seal as known in commerce are derived, the animals resorting to them in immense numbers every spring for the purpose of bringing forth their young. In 1870, an Act was passed by Congress limiting the number to be killed at 100,000. The Alaska Commercial Company secured the lease of the fishery, and has carried out the contract in apparent good faith. The condition of the islanders has been considerably improved. Congress has authorised the appointment of a commission to investigate the natural history and geographical distribution of the fur seal.

FROM the *Monthly Notices* of the Royal Society of Tasmania for June, July, and August, 1873, we learn that the Society has been making an inquiry in reference to the stone implements of the Tasmanian aborigines, especially as to whether the natives made use of these implements fastened to handles, after the manner of axes or tomahawks. All inquiries on the subject tend to prove that no true tomahawks were known to or fabricated by the natives; they merely used sharp-edged stones as knives. These were made sharp, not by grinding or polishing, but by striking off flakes with another stone till the required edge was obtained. As a very general, if not invariable, rule, one surface only was chipped in the process of sharpening. They were made from two different kinds of stone—the one apparently an indurated clay rock, the other containing a large proportion of silex.

A WRITER in the *Times* complaining of the want of labels in the Bird Gallery of the British Museum, states that "A young and active Naturalist has been appointed specially to look after this part of the collections." It is hoped that he will see that all the specimens are furnished with labels.

SOME experiments of particular interest physiologically have been undertaken by Dr. Worm Müller, and are described by him in Ludwig's *Arbeiten* (vol. viii. p. 159), an abstract of which paper will be found in the *London Medical Record* for last week. The author finds that the transfusion into the circulatory system of an amount of blood three times as much as that normally contained in the system does not cause any rise in the arterial blood pressure, though the pulse-rate is reduced. The reduction of the quantity of blood after transfusion, however, causes a rapid fall in the blood-pressure, even when only half that added has been removed. We think that the former of these results is not difficult to explain, for the heart, being an engine with only a limited capacity for work, it can only maintain a certain determinable blood-pressure, depending on the bulk of its muscular parietes. The introduction of an excess of blood to be circulated can therefore act only in filling the system at the expense of the velocity of the current, with a diminution in the rapidity of the cardiac action.

IT may be of some interest with reference to the demand of ladies to be admitted to the ordinary degrees of the University of London, to note that at the recent distribution of prizes at University College the first and second places in the mixed class of Jurisprudence were both occupied by ladies, Miss E. Orme, who two years ago took the prize in the class of Political Economy, coming out first, while in the mixed class of Political Economy a lady this year took the fourth certificate.

DR. W. G. FARLOW has published in the *American Journal of Science and Arts* an account of some investigations carried on in the botanical laboratory of the University of Strasburg, illustrating a remarkable asexual development from the prothallus of *Pteris serulata*. In the centre of the cushion or thickest part of the prothallus were a number of scalariform ducts, the prothallus bearing a number of antheridia, but no archegonia. From these ducts a leaf is developed directly, after which a root is also developed, and last of all a stem-bud. A comparison was drawn between this growth, which was observed in this species only, and the buds produced in the ordinary way from the protonema of a moss. Normally the prothallus of a fern is entirely destitute of vascular tissue of any kind.

DR. McKendrick (*Brit. Med. Journ.*, June 27, 1874) has made a contribution to the subject of the physiological antagonism of medicines which has been so elaborately illustrated by the works of Fraser and Crum Brown. He finds that while Bromal causes an excessively copious secretion of saliva, Atropine quickly arrests it, in rabbits. Possible practical applications of this discovery in the treatment of various kinds of ptyalism in man are at once thought of, and already cases of so-called success in the salivation of pregnancy are recorded.

IN the Bulletin of the Buffalo Soc. Nat. Sci. No. 4, vol. i., will be found a paper by Prof. Hartt on the geology of the Lower Amazons. He determines, on palæontological evidence, that the great plain of the Serra of Ereré is of Devonian age.

AMONG recent additions to the Manchester Aquarium are the following:—1 Smooth Hound or Skate-Toothed Shark (*Mustelus vulgaris*); 2 Topers or White Hound (*Galeus canis*); 2 Picked Dog-fish (*Acanthias vulgaris*); 4 Lesser Spotted Dog-fish (*Syllium canicula*); 4 Greenland Bullheads (*Cottus grœnlandicus*); 3 Gemmeous Dragonets (*Callionymus lyra*); 5 Cat or Wolf-fish (*Anarhicus lupus*); 2 Tadpole Fish (*Raniceps trifurcus*); Zoophytes—*Actinoloba dianthus*, *Sagartia bellis*, *S. nivea*, *S. viduata*, *S. miniate*, *Tealia crassicornis*.

THE additions to the Zoological Society's Gardens during the past week include a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Captain Webster; two Rhesus Monkeys (*Macacus erythræus*) from India, presented by Mr. W. Dunn; 1 Chinese Turtle Dove (*Turtur chinensis*), from India, presented by Major F. Gildea; a Canadian Beaver (*Castor canadensis*) and a Virginian Deer (*Cervus virginianus*), born in the Gardens; a Lanner Falcon (*Falco lanarius*), from east Europe, purchased.

SCIENTIFIC SERIALS

Transactions of the Norfolk and Norwich Naturalists' Society, 1873-74 (Norwich: Fletcher & Son).—This Society is now in the fifth year of its existence, and is in a satisfactory condition as to members. The chief features of the present number of its "Transactions" are Parts IV. and V. of the "Fauna and Flora of Norfolk," which the Society has undertaken to publish. Part IV., by Dr. John Lowe, embraces a list of the fishes known to occur in the Norfolk waters; and Part V. (forming a separate supplement), the Norfolk Lepidoptera, by Mr. C. G. Barrett. Both lists appear to have been done with great care and caution, and we should think that Dr. Lowe and Mr. Barrett have left very little to be added. The catalogues reflect the greatest credit both upon the compilers and on the Society, a few of the wealthier members of which have contributed the greater part of the expense of printing the present supplement. The next instalment of this important work of the Norfolk Society will contain the flowering plants, by Mr. H. D. Geldart. The president's address gives a *résumé* of the year's work of the Society, and discusses the question of Biogenesis.—Mr. F. D. Wheeler contributes a paper On breeding Lepidoptera in confinement, giving the results of the author's own experience; and Mr. F. Kitton one On Empusca and other micro-fungi.—In a short paper by Mr. J. B. Bridgman On the nidification of the Prosopis, the author concludes that this bee forms its "nest in any suitable situation, whether in soft earth or wood, not even despising ready-formed holes, and that it collects and carries home pollen in its mouth, after working it up in a pellet."—Mr. John Quinton contributes notes On the meteorological observations recorded at Norwich during the years 1870-73.—A variety of interesting miscellaneous natural history notes conclude the number. Altogether this Society must be congratulated on its year's work; its first object is "the practical study of natural science," which it seems to be carrying out with considerable faithfulness.

Proceedings of the Bath Natural History and Antiquarian Field Club, vol. iii. No. 1. 1874. This Society, to judge from this number of its "Proceedings," seems to devote itself mainly to antiquarian research, "Natural History," though it comes first in its title, seeming to find but small favour among the members. This defect the secretary animadverts strongly upon in his "Summary of Proceedings," stating, moreover, that the club was originally started for the purpose of botanical research. We do not undervalue antiquarian research, but we think it a pity that a club containing so many intelligent and well-educated members should fritter away almost its entire time and strength in a department that could be very satisfactorily worked by a small proportion of its members, to the almost entire neglect of the rich field presented by the district around Bath for Natural History investigation. We hope that the next number of its Proceedings will show that the suggestions of the secretary have been adopted. The only two natural history papers in this number are by Mr. C. E. Broome, F.L.S., On some of the fungi found in the Bath district, the present paper including Order 10, Myxogasters, and a short note by the Rev. Leonard Blomefield, F.L.S., On the occurrence of the Land Planaria (*Planaria terrestris*) in the neighbourhood of Bath. Dr. Bird was the first to discover this animal (supposed to be the only species of Land Planaria in western Europe) in the Bath district, and Mr. Blomefield is inclined to believe it to be carnivorous, making a prey of the smaller land molluscs. The secretary gives an extremely interesting summary of the meetings and excursions of the Society during 1873-74.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, June 1.—The observations of M. Marié Davy on the diminution of certain river waters in France are here closed with a discussion on the influence of different kinds of vegetation growing in their basins. It is shown that waste open land evaporates the least amount of rain-water, and forests less than corn or other farm produce. The increase of high farming and artificial meadow-land, absorbing and evaporating much moisture, must diminish the size of streams by robbing them of part of their supply, and to keep up the summer flow of a river it might be thought desirable to plant its upper basin with forests. Comparison of different rivers shows, however, that no valuable addition would thus be gained. Whatever be the origin of the river, geological conditions are alone effective. Therefore, although as a measure of national economy, for fixing soil on slopes, mitigating floods and changes of level, and providing cheap fuel, the maintenance of forests would be beneficial, we must look forward to a time when the art of storing some of the excess of winter rainfall to supply the needs of summer will be adopted in agriculture.—Among the "Kleinere Mittheilungen," Prof. Prestel deduces from twenty years' measurement of ozone a result similar to that of Herr Karlinski at Krakau, showing a minimum in November or December and a maximum in the spring.—The work of Herr Edlund on the mean temperature of Sweden, and a delicate form of Goldschmidt's aneroid, are here noticed.

Schriften der Naturforschenden Gesellschaft in Danzig, 1873.—The history of the population in the eastern provinces of Prussia is still involved in much obscurity, while that of the remaining provinces is pretty accurately known. In one of the papers in this volume Dr. Marshall considers the evidence obtainable from early writers—Pliny, Tacitus, &c.—from names of persons and places, and more especially from the archæological collections, of which there are two, imperfectly arranged, in Königsberg. From a study of grave-relics, Dr. Marshall is led to the conclusion that, at one time, in these eastern provinces two distinct races lived together. Several races having come from the east and settled in the coast-lands of the Baltic, more than 1,000 years B.C., this land was, later, overrun by Goths from central Russia, many of whom pressed on to Scandinavia and the Danish Islands, and to western and southern Europe; but a number remained on the amber coast, especially in the Weichsel region, and became fused with the Aestian or Wend race, already there; they were together known as *Pruzzen*.—Among the papers is another giving an account of a chemical analysis (made by direction of Dr. Friederici) of certain empty grave-urns of the ancient Prussians, the significance of which has not been clearly ascertained. Dr. Friederici thinks they were in themselves sacred vessels; they are made not from clay, but from ashes, firmed probably with blood of animals killed in sacrifice. In heating, the blood and the carbon particles at the surface had been turned to ashes, presenting a reddish-yellow appearance, while the internal substance was merely carbonised, and darker in colour.—Dr. Lissauer gives an account (with excellent photographs) of some more of those curious face-urns that have been found in large numbers in certain parts of Pomerania; and M. Kasioki describes a number of antiquities of various kinds discovered in Pomerania during 1872.—Dr. Lebert, who has been experimenting on the fluorescence of some specimens of Sicilian amber, finds the phenomenon in these much more marked and frequent than in Prussian amber; in the case of the latter he has observed, with strong sunlight, not only the existence, but the manifold character of the cone of light.—A valuable paper on new and extended employment of the level for astronomical and geodetic measurements is contributed by M. Kayser, and M. Menge continues a list and description of Prussian spiders.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 18.—On the Forces caused by Evaporation from and Condensation at a Surface, by Prof. Osborne Reynolds, of Owens College, Manchester.

It has been noticed by several philosophers, and particularly by Mr. Crookes, that, under certain circumstances, hot bodies appear to repel and cold ones to attract other bodies. It is my object in this paper to point out and to describe experiments to prove that these effects are the results of evaporation and condensation; and that they are valuable as evidence of the truth of the kinetic theory of gas, viz. that gas consists of separate molecules moving at great velocities.

The experiments of which the explanation will be given were as follows:—

A light stem of glass, with pith-balls on its ends, was suspended by a silk thread in a glass flask, so that the balls were nearly at the same level. Some water was then put in the flask and boiled until all the air was driven out of the flask, which was then corked and allowed to cool. When cold there was a partial vacuum in it, the gauge showing from ½ to ¾ of an inch pressure.

It was now found that when the flame of a lamp was brought near to the flask the pith-ball which was nearest the flame was driven away; and that with a piece of ice the pith was attracted.

This experiment was repeated under a variety of circumstances, in different flasks and with different balances, the stem being sometimes of glass and sometimes of platinum; the results, however, were the same in all cases, except such variations as I am about to describe.

The pith-balls were more sensitive to the heat and cold when the flask was cold and the tension within it low, but the effect was perceptible until the gauge showed about an inch, and even after that the ice would attract the ball.

The reason why the repulsion from heat was not apparent at greater tensions was clearly due to the convection currents which the heat generated within the flask. When there was enough vapour, these currents carried the pith with them; they were, in fact, then sufficient to overcome the forces which otherwise moved the pith. This was shown by the fact that when the bar was not quite level, so that one ball was higher than the other, the currents affected them in different degrees; also that a different effect could be produced by raising or lowering the position of the flame.

The condition of the pith also perceptibly affected the sensitiveness of the balls. When a piece of ice was placed against the side of the glass, the nearest of the pith-balls would be drawn towards the ice, and would eventually stop opposite to it. If allowed to remain in this condition for some time, the vapour would condense on the ball near the ice, while the other ball would become dry (this would be seen to be the case, and was also shown by the tipping of the balance, that ball against the ice gradually getting lower). It was then found when the ice was removed that the dry ball was insensible to the heat, or nearly so, while that ball which had been opposite to the ice was more than ordinarily sensitive.

If the flask were dry and the tension of the vapour reduced with the pump until the gauge showed ⅜ of an inch, then, although purely steam, the vapour was not in a saturated condition, and the pith-balls which were dry were no longer sensitive to the lamp, although they would still approach the ice.

From these two last facts it appears as though a certain amount of moisture on the balls was necessary to render them sensitive to the heat.

In order that these results might be obtained it was necessary that the vapour should be free from air. If a small quantity of air was present, although not enough to appear in the gauge, the effects rapidly diminished, particularly that of the ice, until the convection currents had it all their own way. This agrees with the fact that the presence of a small quantity of air in steam greatly retards condensation and even evaporation.

With a dry flask and an air-vacuum, neither the lamp nor the ice produced their effects; the convection currents reigned supreme, even when the gauge was as low as ¼ inch. Under these circumstances the lamp generally attracted the balls and the ice repelled them, *i.e.* the currents carried them towards the lamp and from the ice; but by placing the lamp or ice very low the reverse effects could be obtained, which goes to prove that they were the effects of the currents of air.

These experiments appear to show that evaporation from a surface is attended with a force tending to drive the surface back, and condensation with a force tending to draw the surface forward. These effects admit of explanation, although not quite as simply as may at first sight appear.

Although there must always be reaction corresponding to the visible motion, whenever vapour is driven off from a surface, this visible motion is too small to account for the forces under consideration. But, although it appears to have escaped notice so far, it follows as a direct consequence of the *kinetic* theory of gases that whenever evaporation takes place from the surface of a solid body or a liquid, it must be attended with a reactionary force equivalent to an increase of pressure on the surface, which force is quite independent of the perceptible motion of the vapour. Also condensation must be attended with a force equivalent to a diminution of the gaseous pressure over the condensing surface, and likewise independent of the visible motion of the vapour. This may be shown to be the case as follows:—

According to the kinetic theory the molecules which constitute the gas are in rapid motion, and the pressure which the gas exerts against the bounding surfaces is due to the successive impulses of these molecules, whose course directs them against the surface, from which they rebound with unimpaired velocity. According to this theory, therefore, whenever a molecule of liquid leaves the surface henceforth to become a molecule of gas, it must leave it with a velocity equal to that with which the other particles of gas rebound—that is to say, instead of being just detached and quietly passing off into the gas, it must be shot off with a velocity greater than that of a cannon-ball. Whatever may be the nature of the forces which give it the velocity, and which consumes the latent heat in doing so, it is certain, from the principle of conservation of momentum, that they must react on the surface with a force equal to that exerted on the molecule, just as in a gun the pressure of the powder on the breech is the same as on the shot.

The impulse on the surface, from each molecule which is driven off by evaporation, must therefore be equal to that caused by the rebound of one of the reflected molecules (supposing all the molecules to be of the same size), that is to say, since the force of rebound will be equal to that of stopping the impulse from a particle driven off by evaporation will be half the impulse received from the stopping and reflection of a particle of the gas. Thus the effect of evaporation will be to increase the number of impulses on the surface; and, although each of the new impulses will only be half as effective as the ordinary ones, they will add to the pressure.

In the same way, whenever a molecule of gas comes up to a surface and instead of rebounding is caught and retained by the surface, and is thus condensed into a molecule of liquid, the impulse which it will thus impart to the surface will only be one-half as great as if it had rebounded. Hence condensation will reduce the magnitude of some of the impulses, and hence will reduce the pressure on the condensing surface.

This explanation is then put in a mathematical form, and the paper proceeds.

Applying these results to steam, we find that at a temperature of 60° the evaporation of 1 lb. of water from a surface would be sufficient to maintain a force of 65 lbs. for one second.

It is also important to notice that this force will be proportional to the square root of the absolute temperature, and consequently will be approximately constant between temperatures of 32° and 212°.

If we take mercury instead of water, we find that the force is only 6 lbs. instead of 65; but the latent heat of mercury is only $\frac{1}{30}$ that of water, so that the same expenditure of heat would maintain nearly three times as great a force.

It seems, therefore, that in this way we can give a satisfactory explanation of the experiments previously described. When the radiated heat from the lamp falls on the pith its temperature will rise, and any moisture on it will begin to evaporate, and to drive the pith from the lamp. The evaporation will be greatest on that ball which is nearest to the lamp, therefore this ball will be driven away until the force on the other becomes equal, after which the balls will come to rest, unless momentum carries them further. On the other hand, when a piece of ice is brought near the temperature of the pith it will be reduced, and it will condense the vapour and be drawn towards the ice.

The reason why Mr. Crookes did not obtain the same results with a less perfect vacuum was because he had then too large a proportion of air or non-condensing gas mixed with the vapour, which also was not in a state of saturation. In the experiments the condensable vapour was that of mercury, or something which required a still higher temperature, and it was necessary that the vacuum should be very perfect for such vapour to be anything like pure and in a saturated condition. As soon, however, as this state of perfection was reached, then the effects were more apparent than in the corresponding case of water. This agrees well with the explanation; for, as previously shown, the effect of mercury would for the same quantity of heat be three times as great as that of water; and besides this, the perfect state of the vacuum would allow the pith (or whatever the ball might be) to move much more freely than when in the vapour of water at a considerable tension.

Of course the reasoning is not confined to mercury and water; any gas which is condensed or absorbed by the balls when cold in greater quantities than when warm would give the same results; and as this property appears to belong to all gases, it is only a question of bringing the vacuum to the right degree of tension.

There was one fact connected with Mr. Crookes' experiments which, independently of the previous considerations, leads me to the conclusion that the result was due to the heating of the pith, and was not a direct result of the radiated heat.

In one of the experiments exhibited at the Soirée of the Royal Society, a candle was placed close to a flask containing a bar of pith suspended from the middle; at first the only thing to notice was that the pith was oscillating considerably under the action of the candle; each end of the bar alternately approached and receded, showing that the candle exercised an influence similar to that which might have been exercised by the torsion of the thread had this been stiff. After a few minutes observation, however, it became evident that the oscillations continued instead of gradually diminishing, as one naturally expected them to do; and, more than this, they actually increased, until one end of the bar passed the light, after which it seemed quieter for a little, though the oscillations again increased until it again passed the light.

The explanation given is that, owing to the slowness with which the pith takes in and gives out heat, its ends will on the whole be hotter while receding from than while approaching the candle, and hence the force, as a mean, will be greater on that end which is receding, and there will be a continual oscillation.

Since writing the above paper, it has occurred to me that, according to the kinetic theory, a somewhat similar effect to that of evaporation must result whenever heat is communicated from a hot surface to gas.

The particles which impinge on the surface will rebound with a greater velocity than that which they approached, and consequently the effect of the blow must be greater than it would have been had the surface been of the same temperature as the gas.

And in the same way whenever heat is communicated from a gas to a surface the force on the surface will be less than it otherwise would be, for the particles will rebound with a less velocity than that at which they approach.

It is then shown mathematically, that for every English unit of heat communicated to steam at a temperature of 60°, the reaction on the surface is equivalent to ·38 lb. acting for one second; and in the same way for air the force is equivalent to ·55 lb. It is also pointed out that since the diffusion of heat within a gas is inversely proportional to its density, the amount of heat communicated from a surface to the surrounding gas is independent of the density of the gas, and hence, that the reaction on the pith in Mr. Crookes' experiments would remain constant as the vacuum improved, while the counteracting forces would diminish and leave the balls more free to move. It is therefore assumed that the results obtained in those experiments might have been at least in part due to such forces.

Linnean Society, June 19.—Dr. G. J. Allman, F.R.S., president, in the chair.—Mr. D. Hanbury, treasurer, exhibited branches of olive grown in the open air at Clapham, some bearing flowers, others nearly ripe fruit; also a specimen of *Rheum officinale* Baill., now grown in this country for the first time, the source of the true medicinal Turkey rhubarb, and pointed out the characters in which it differs from other species of the genus.—Dr. Hooker made a communication on the subject of some India *Garcinias* to the effect:—(1) That the *G. indica* Chois. (*purpurea* Roxb.), had been placed in a wrong section in Anderson's review of the genus in the "Flora of British India." (2) That the plant described in the same work as *G. griffithii* is proved to be the true Gamboge plant of Siam, *G. pinella*, var. *pedicellata* of Hanley, which Dr. Hooker regards as a distinct species, and proposes that the name of *G. hanburyi* should be given to it. (3) That the *G. brevirostris* of Scheffer is identical with *G. eugeniæfolia* of Wallich. (4) That the name of *G. ovalifolia* Hook. f., must give place to the previously published *G. ovalifolia* of Oliver's "Flora of Tropical Africa;" and the Indian plant must take the name of *spicata*, it being a form of *Xanthochymus spicatus* W. et A.—Prof. Thiselton Dyer exhibited a young oak-plant with three cotyledons, which had been sent to him by Mr. Cross, of Chester; also a pitcher-like development of a leaf of the common cabbage, from Harting, Sussex, sent by Mr. H. C. Watson to the Kew Museum.—Mr. A. W. Bennett exhibited drawings of the style, stigma, and pollen-grain of *Pringlea antiscorbutica* Hook. f., describing the remarkable manner in which the pollen of *Pringlea* differs from that of other nearly allied Crucifers, being much smaller and perfectly spherical, instead of elliptical with three furrows. This he considered a striking confirmation of Dr. Hooker's suggestion that we have here a wind-fertilised species of a family ordinarily self-fertilised, a hypothesis which is again confirmed by the total absence of hairs on the style of *Pringlea*.—An extract was read of a letter from Mr. Harry Bolus to Dr. Hooker, F.RS., dated Graaf Reinet, April 4, 1874, in which he comments adversely on some of the reasonings contained in Grisebach's "Vegetation der Erde" in favour of the theory of "independent centres of creation." Grisebach, relying chiefly on an observation of Burchell's, makes the Orange river the boundary between the Cape and Kalahari provinces, a boundary which Mr. Bolus shows to be untenable, at least in certain portions. Grisebach unites the Kanoo flora with that of the Cape province; while Mr. Bolus doubts whether it does not differ more from this than from the Kalahari. The Roggeveld, and indeed the whole Kanoo, by its predominance of shrubby Compositæ, seems to incline more to the desert type of plants than to the richer Cape flora.—The following papers were then read, viz.:—On the resemblances between the bones of typical living reptiles and the bones of other animals, by Harry G. Seeley. —On the Auxenmeæ, a new tribe of Cordiaceæ, by J. Miers. —A revision of the sub-order Mimoseæ, by G. Bentham, LL.D.—On some fungi collected by Dr. S. Kurz in Yomah, Pegu, by F. Currey.—Notes on the letters from Danish and Norwegian naturalists contained in the Linnean correspondence, by Prof. J. C. Schiodte, of Copenhagen.

Geological Society, June 10.—John Evans, F.R.S., president, in the chair.—The following communications were read:—On the occurrence of Thanet-beds and a crag at Sudbury, Suffolk, by William Whitaker. After referring to some passages in papers by Mr. Prestwich, in which the probable existence of Thanet-beds in North Essex is mentioned, the author described certain sections near Balingdon, on the right bank of the Stour, which exhibit sands belonging to this series. The crag-beds described by the author are found on the left bank of the Stour, in Suffolk, and consist of ferruginous dark reddish-brown sand, with layers of ironstone, slightly false-bedded, with here and there light-coloured grit with broken shells.—Notes on the phenomena of the Quaternary Period in the Isle of Portland and around Weymouth, by Joseph Prestwich, F.R.S. Commencing with the oldest drift-beds, the author showed that the remains of one, formerly more extensive, had been found in the Isle of Portland at a height of 400 ft. above the sea; that it contained the remains of the *Elephas antiquus*, *Equus fossilis*, &c.; and that he found in this bed a number of pebbles of sandstone and ironstone of Tertiary age, and of chert from the Greensands, whence he inferred that, as such pebbles could not now pass over the plain of Weymouth, they must have done so before that area was denuded, and when bridged over by the Portland and Purbeck beds; for the pebbles are derived from beds which are only *in situ* to the north of the Weymouth district, and at a distance of eight to ten miles from Portland. Further, this transport must have taken place before the elevation of the north end of Portland, and when the slope from the Bill to the Ridgeway was uniform and gradual. The anticlinal line, which has elevated the intermediate area, must be of later date than the drift-bed. The author next proceeded to notice the raised beach at the Bill of Portland, in which he had, with the assistance of Mr. Jeffreys, determined twenty-six species of shells, two of them not now living in the British Channel, and one new. This beach contains pebbles of the Devonshire and Cornwall rocks. The raised beach Mr. Prestwich found to abut against an old cliff that had been swamped at a later geological period by a land-wash, which had levelled it and the old sea-land with the adjacent land-surface. The mass which had thus swamped the cliff and buried the beach consisted of loam and angular *débris*, the latter being in larger proportion at top. In the loam he found several species of land and fresh-water shells and fragments of bones. The angular *débris* consisted of pieces of the local rocks, together with a number of specimens, which by their organic remains were shown to belong to the Middle Purbecks, a part of the series not now existing in Portland. A similar bed, but much thicker, was then described at Chesilton, in the north of the island. It is there 60 ft. thick, and contains large blocks of Portland stone and Portland chert, the greater number of which are in the upper part of the deposit, which is here on the sea-level, and 400 ft. lower than the Portland escarpment which rises above it. This loam and angular *débris* the author was disposed to attribute to a temporary submergence of the land to a depth exceeding the height of Portland, and by which the land as it emerged was swept, and its *débris* carried down to the lowest levels, with the remains of its land-animals and land and fresh-water shells, which latter, where protected by large masses of loam and suddenly entombed, have been preserved uninjured. To this deposit, which is common over the raised beaches on the south coast, the author proposed to apply the term "land-wash." The paper concluded with a short notice of the drift-beds formed subsequently to the denudation of the Weymouth district, and therefore never on the high-level Portland drift.—On the character of the diamantiferous rock of South Africa, by Prof. N. Story Maskelyne, F.R.S., Keeper, and Dr. Flight, Assistant, of the Mineralogical Department, British Museum. In this paper the authors confirmed certain statements made by one of them from a superficial examination of specimens brought to this country by Mr. Dunn. The specimens examined and analysed by Dr. Flight were obtained from various diggings and from different depths, down to 180 ft. in the case of one mass from Colesberg Kopje. Their characters throughout are essentially the same. The rock consists of a soft and somewhat pulverulent ground-mass, composed of a mineral (soapy to the touch) of a light yellowish colour in the upper, and of an olive-green to bluish-grey colour in the lower parts of the excavations. Interspersed in the mass are fragments of more or less altered shale, and a micaceous-looking mineral of the vermiculite group, which sometimes becomes an important constituent of the rock, which also contains bright green crystals of a ferruginous enstatite (bronzite), and sometimes a horn-blendic mineral closely resembling smaragdite. A pale buff bronzite occurs in larger fragments than the green form of the mineral; and in the rock of Du Toit's pan an altered diallage is present. Opaline silica, in the form of hyalite or of hornstone, is disseminated through the greater part of the rock-masses, and they are everywhere penetrated by calcite. The analyses of the component minerals (given in detail in the paper) show that this once igneous rock is a bronzite rock converted into a hydrated magnesium silicate, having the chemical characters of a hydrated bronzite, except where the remains of crystals have resisted metamorphism. Except in the absence of olivine and the small amount of augitic mineral, it might be compared with the well-known Lherzolie rock. The diamonds are said to occur most plentifully, or almost exclusively, in the neighbourhood of dykes of diorite which intersect the hydrated rock, or occur between it and the horizontal strata through which the igneous rocks have been projected. The authors compare the characters of the diamonds found in different positions, and come to the conclusion that their source is not very remote from that in which they are now found. The mineral above-mentioned as resembling vermiculite is described by the authors as a new species under the name of Vaalite.—Note on a modified form of Dinosaurian ilium, hitherto reputed scapula, indicative of a new genus, or possibly of a new order of reptiles, by J. W. Hulke, F.R.S. The author re-examines Mantel's "Scapula of an unknown reptile" = Owen's "Scapula of Megalosaurus?" and adduces reasons for considering it to be a modified Dinosaurian ilium. He describes two new examples of the bone in Dr. Wilkins's collection, contrasts them with undoubted scapulæ of sundry Dinosaurs and existing reptiles, and proves their essential correspondence with the ilia of known Dinosaurs.—Note on a reptilian tibia and humerus (probably of *Hylæosaurus*) from the Wealden formation in the Isle of Wight, by J. W. Hulke, F.R.S. In this communication the author describes two saurian limb-bones, remarkable for the great expansion of their articular ends, and the shortness and smallness of their shaft. The features of the tibia are more like those of the tibia of *Hylæosaurus* than of any other Dinosaur. This resemblance, and the suitability of the humerus to the very massive articular end of the Hylæosaurian scapula, dispose the author to refer the bones to this saurian.

Royal Horticultural Society, June 17.—Scientific Committee.—Dr. J. D. Hooker, C.B., P.R.S., in the chair.—Specimens of *Puccinia malvacearum* (the hollyhock disease) were exhibited from Mr. Fish.—Dr. Masters showed a large slab of the wood of the Encine (*Quercus humilis*).—Mr. Worthington Smith exhibited a woodcut block of ebony which he pronounced nearly as good as box, but objectionable on account of its dark colour.—Dr. Denny showed flowers of a scarlet Pelargonium raised by him, in which the petals were remarkably persistent. He had obtained this horticulturally desirable quality by continuous breeding and selection from a variety originally manifesting it in a smaller degree.

General Meeting.—W. A. Lindsay, secretary, in the chair.—Prof. Thiselton Dyer commented on the interesting series of lilies exhibited by Mr. Barr, which illustrated four distinct geographical races all belonging in a wide sense to the same species. *Lilium bulbiferum*. *L. bulbiferum* proper was wild in Austria and Sweden; *L. croceum* in France, Switzerland, and North Italy; *L. davuricum* in Siberia, *L. thunbergianum* in Japan. It could not be doubted that these were all derived from a common parentage, and had been gradually differentiated as they migrated in different directions and became isolated.—He also described the coffee blight of Ceylon and South India (*Hemileia vastatrix*). A dried bush exhibiting the effects of the disease was shown on the table.—Dr. Hooker illustrated in some detail the light which the theory of a common parentage threw on the geographical distribution of closely allied species, varieties, or forms. He pointed out as particularly striking cases the cedars and the 5-leaved pines. As to the *Hemileia* it could not be doubted that it was a most serious enemy for the planters to contend with. He thought, however, that there was some hope that particular kinds of coffee might be found to be less liable to its attacks than others, and at Kew he had been making great efforts to procure and raise from seed the remarkably large-seeded West African kind with a view to its transmission to Ceylon.

Anthropological Institute, June 23.—Prof. Busk, F.R.S., president, in the chair.—Mr. Robert Dunn read a paper On ethnic psychology. The author dwelt on the importance of carefully studying the cerebral organisation of the typical races as the only way of elucidating the psychological differences which exist among them. Notwithstanding the labours of Gratiolet in that field of inquiry, a vast deal remained to be done. The author's convictions rested on the postulate that the brain is the instrument of the mind, and the consequent corollary was that the distinguishing psychical differences existing between various peoples depend greatly, if not altogether, on the structural differences of their brains.—A paper, by Mr. Rooke Pennington, was read, On the relative ages of cremation and contracted burial in Derbyshire in the Neolithic and Bronze ages. The object of the paper was to show that the impression that stone implements and contracted burial, bronze implements and cremation, are usually associated is quite erroneous as tested by the results of barrow-opening in the Peak of Derbyshire. The researches of Messrs. Bateman and Carrington on being tabulated proved that. Of "finds" containing stone implements, 65 per cent. were cases of contracted burial, 34 per cent. were burnt. In the Bronze, 58 per cent. were contracted, 38 per cent. were burnt. It was clear that those who deposited stone implements in the graves of the dead, and those who placed there articles of bronze, shared pretty equally the differences of custom in the interment of the body: so that out of 150 contracted entombments, 50 per cent. were accompanied by stone only, 12 per cent. by bronze; and out of 86 burnt cases, 46 per cent. afforded stone only, 14 per cent. bronze. The conclusion was fully borne out by examination of the contents of each tumulus. Several instances were given as showing that the Neolithic and Bronze peoples alike used both modes of burial.—A paper, by Miss A. W. Buckland, was read, On mythological birds ethnologically considered. The chief object of the author was to prove that in tracing the bird-legends to their sources, valuable ethnological results might be obtained, and a clue afforded to the migrations of man in Prehistoric times.—The president took the opportunity on this, the last ordinary meeting of the session, of announcing that the appeal of Council to the body of members at the anniversary had been so successful that the Institute was now out of debt.

Geologists' Association, June 5.—Henry Woodward, F.R.S., president, in the chair.—On the lower cretaceous beds of Folkestone, by F. G. H. Price, F.G.S. The town of Folkestone is situated upon the Folkestone Beds of the Upper Neocomian. These the author divides into four lithological groups, commencing with a sandy bed, which contains many phosphatic nodules, and which he considers to form the true division between the Folkestone and underlying Sandgate beds. The *Rhynchonella sulcata* bed, an important fossiliferous zone, lies at the base of the latter. The general character of these Folkestone beds is that of a loose yellowish sand parted by seams of coarse calcareous sandstone. Masses of branching sponge are especially plentiful in these rocks. The last bed of the Folkestone series is a very remarkable one, consisting of an irregular seam of large nodular masses, composed of coarse grains of quartz, glauconite, jasper, lydian-stone, and phosphatic nodules. Four feet of loose sand succeeds, capped by a band of pyritous nodules; and then occurs a seam of dark greensand (containing two lines of phosphatic nodules), largely charged with *Am. interruptus*, and other fossils in the form of rolled casts. The argillaceous beds of the lower gault, which follow, are frequently very dark in colour, and more or less parted off by lines of nodules, marking certain zones of life. The thickness of this sub-formation is about 28 ft. From the grey marl or upper gault it is separated by a nodule or passage bed of much importance; as this nodule bed marks the extinction of lower-gault forms and the introduction of others. The base of the upper gault may be known by the large quantities of *Inoceramus sulcatus*. The upper fifty feet consists of a pale grey marl, of which the portion subjected to analysis yielded 26 per cent. of lime carbonate.—On a collection of fossils from the U.G.S. of Morden, Camb., by H. George Fordham, F.G.S.

Entomological Society, June 1.—Sir Sidney S. Saunders, president, in the chair.—Mr. McLachlan exhibited specimens of the White Ant (*Calotermes* sp.), recently bred at Kew from a sample of the wood of the tree (*Trachylobium hornmannianum*) that produces the gum-copal of Zanzibar.—Mr. Stainton read a letter he had received from the Rev. P. H. Newnham, of Stonehouse, Devon, stating that he had taken two living specimens of *Deiopeia pulchella* on the Cornish side of the River Tamar. Mr. Stainton remarked on the early period of the year when the insects were captured as very unusual.—Mr. C. O. Waterhouse sent for exhibition a living specimen of a Mantid (*Empusa pauperata*) in the larva or pupa state, brought from Hyères by the Rev. Mr. Sandes of Wandsworth.—Mr. W. D. Gooch communicated a detailed account of his experiences with regard to the Longicorn Coffee-borers of Natal. Dr. Horn, of Philadelphia, stated that European Conifers, Limes, &c., planted in a public park at Philadelphia, were all killed by the larvæ of native species, such as *Callidium antennatum* and *Manohammus dentator*, though apparently in a healthy condition, whilst the native trees were not perceptibly affected. He was inclined to believe that the insects attacked healthy trees, but Mr. McLachlan stated that, according to the observations of most European entomologists, the European species of Longicorns did not attack living wood in a perfectly healthy state.—Mr. Butler communicated a paper On new species and a new genus of diurnal Lepidoptera in the collection of Mr. Druce.—Mr. Smith read a revision of the Hymenopterous genera *Cleptes*, *Parnopes*, *Anthracias*, *Pyria*, and *Stilbum*, with descriptions of new species of the genus *Chrysis*, from North China and Australia.

PARIS

Academy of Sciences, June 22.—M. Bertrand in the chair.—M. Dumas stated, in the name of the *Phylloxera* Commission, that after the theoretical researches of the Commission this body had commenced a practical study of the subject in the field. Agricultural police had been appointed for the preservation of those parts of France not yet invaded by the scourge.—The following papers were read:—Researches on solution, by M. Berthelot; a continuation of thermo-chemical investigations.—Presentation of some specimens of photography obtained with an apparatus constructed for the Japanese expedition, by M. J. Janssen. The photographs presented were of the sun taken with an objective (of 5 in. aperture and 2 metres focus), constructed of flint and crown glass in achromatic combination.—A mechanical note was presented by M. R. Clausius, entitled "On a special case of the Viriel."—Theory of the collision of bodies, with consideration of the atomic vibrations, by M. A. Ledieu.—Communication on the bitter lakes of the Isthmus of Suez, by M. Ferdinand de Lesseps. The author exhibited a block of salt cut out from the salt bank still existing in the centre of the great basin. This bank is calculated to have contained 970,000,000,000 kilogrms. of salt, and has now dissolved away to the extent of $\frac{1}{6}$ since the admission of the water of the canal. The superficial area of the salt bank is about 66,000,000 square metres, and it is composed of horizontal layers varying in thickness from 5 to 25 centims. The bank is believed to have been formed by the evaporation of Red Sea water poured into the lake basin during successive inundations; the amount of Red Sea water evaporated is about 21,000,000,000 cubic metres. The lake basin contains 2,000,000,000 cubic metres of water, giving an annual evaporation of 200,000,000 cubic metres. Twenty years ago rain hardly ever fell in the isthmus, but now tiles are obliged to be sent from France to roof the houses there. The author holds out great hopes of the practicability of filling a great basin in the interior of Algeria. A valuable table of numerical results accompanied the communication.—Geological topography of the environs of Aigues-mortes, a letter from M. Ch. Martins to M. Elie de Beaumont.—Observations on the subject of the reply of M. Faye to the criticism concerning his addition to Pouillet's memoir on solar radiation, by M. A. Ledieu. The author insisted that there was still a difference in the *principles* of thermodynamics between him and M. Faye.—Analysis of twenty-one samples of salt water from the maritime canal of Suez, sent by M. F. de Lesseps, by M. Durand-Claye. While Mediterranean water contains a solid residue of about 40 kilogrms. per cubic metre, the canal water contains, in some parts, 75 kilogrms., and never falls below 65 kilogrms. This fact is explained by the solution of the great salt bank before referred to. At Port Said the water is less salt than in the Mediterranean (24 to 26 kilogrms.) owing to admixture with Nile water.—On the employment of phenic acid for the preparation of wood, by M. M. Boucherie.—On the Cycadaceæ of the Paris basin, a note by M. Robert. Among a number of rolled flints from the confluence of the Nesle and Aisne between Ciry-Sermoise and Chasemy, the author found a number of stems which he considers to belong to the order named.—On the systems of quadratic forms, by M. C. Jordan.—M. G. Darboux made an addition to his note read on June 8, On friction in the collision of bodies.—Hydrographic map of Algeria, a note by M. E. Mouchez.—Phenomenon of mirage observed in Yffiniac Creek (North coast), by M. J. Girard.—Action of heat on the isomeric carbides of anthracene and their hydrides, by M. P. Barbier.—Chlorobromides of propylene: normal propyl-glycol, by M. E. Reboul. Only one chlorobromide of propylene has been known up to the present time, viz. $CH_2Br-CHCl-CH_3$ (Friedel and Silva). The author now makes known the four others, $CH_2Br-CH_2-CH_2Cl$ (normal), $CH_3-CClBr-CH_3$, $CH_3-CH_2-CHClBr$, and $CH_3\cdot CHBr-CH_2Cl$.

BOOKS RECEIVED

COLONIAL.—Report of Progress of Geological Survey of Victoria, &c.: R. Brough Smyth (Melbourne).—Report upon the Rainfall of Barbados, and its Influence upon the Sugar Crops: Governor Rawson (Barbados).

FOREIGN.—L'Astronomie Pratique et les Observations en Europe et en Amérique: C. Andre et G. Rayet (Gauthier Villars, Paris).—Die neue Sternwarte der Wiener Universität: Carl von Lithow—Jahresbericht des Physikalischen Central Observatoriums for 1871-72: H. Wild (St Petersburg)—Annalen des Physikalischen Central Observatoriums: H. Wild, 1872 (St. Petersburg)—Spectres Lumineux: M. Lecoq de Boisbaudran. 2 vols. 8vo. (Gauthier Villars).—Repertorium für Meteorologie Kaiserlichen Academie, Redigirt: Dr. Heinrich Wild. Band iii.—Bulletin de l'Academie Imperiale des Sciences de St Petersbourg, t. xviii, Parts iii. iv. v.—Bulletin de l'Academie Imperiales des Sciences de St. Petersbourg, t. xix., Parts i. ii. iii.

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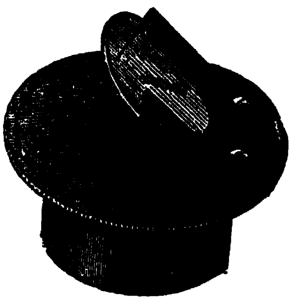

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THURSDAY, JULY 9, 1874

THE COMET

TO those who are familiar with the triumphs which that most wonderful of modern instruments of research—the spectroscope—has achieved, the short time during which it has been at work will be most forcibly recalled by a reference to the circumstance that the comet which is now, astronomically speaking, a magnificent object in the northern sky, is the first one of any considerable brilliancy which has shown itself since the spectroscope has been adapted to the telescope.

The truly splendid comets which delighted us during the autumn of 1858, and for a brief space in the summer of 1861, made their appearance, in fact, during what we may term the pre-spectroscopic age; for, however little to the credit of modern science it might have been that the spectroscope was no employed in their investigation, the fact remains that they were allowed to pass away mere telescopic objects, and that two opportunities were thus lost such as, perhaps, may not offer themselves again to the present generation of men.

I propose, in the present paper, to state some points of inquiry regarding comets in which the spectroscope may help us, with a view of showing how much closer is our grip of celestial phenomena when physical astronomy, in its widest sense, is superadded to the older astronomy, and to indicate the numerous gains to knowledge which may be hoped for if adequate telescopes, properly armed with spectroscopes, are employed both here and in the southern hemisphere upon the present visitor.

Omitting all reference to the paths of comets round the sun, with which mechanical astronomy has to do, there are perhaps but few points in which the spectroscope cannot help us; somewhat unfortunately, however, there is one in which it appears powerless, and that precisely one of the greatest difficulty in cometary theory. I allude to the apparent sweep of the tail round the sun when the comet is at its perihelion point, which has suggested to Faye a theory of a repulsive force due to solar heat, and which perhaps is one of the most mysterious phenomena which we witness in the skies. Leaving this aside, however, there are many questions relating to what Sir John Herschel terms their "interior economy," in which, undoubtedly, the guesses of telescopic observers may be turned into hard, detailed fact.

Let us briefly refer to some of these points.

Generally speaking, as a comet approaches the sun it gets brighter and its tail lengthens, whether the nucleus is intensely stellar, as in the present case, or not; in some cases a violent action may be observed; *aigrettes*, or jets, make their appearance; and the nucleus, or head, is surrounded, or partly surrounded, by envelopes or shells, very obvious and with marked boundaries, and these are visible in some cases at the commencement of the tail.

Now, of course, if any or all of these luminous phenomena were due to the reflection of sunlight by masses of whatever kind not luminous in themselves, then the spectrum would be the same from all, differing only in intensity, and the spectrum would be the true solar spectrum if there were light enough, and a dim continuous spectrum if the part of the comet under examination were dim.

If, on the other hand, the masses were self-luminous and consisted of vapours not too dense, then we should get a characteristic spectrum proving first the existence of vapours driven into incandescence; and secondly, if the observations went far enough, the precise quality or nature of the vapour would be determined for us by the spectroscope. Thanks to the labours of Donati, Huggins, Secchi, Wolf, Rayet, Vogel, and others, the brightest portions of the comets which have appeared since 1864 have been examined with the undoubted result that they consist, in part at least, of not very dense incandescent vapour. I say in part, because in some cases the continuous spectrum, which may denote dense vapours, or perhaps vapours of relatively greater molecular complication, or again even glowing solid substances, has been so strong as almost entirely to mask the bright lines or bands by means of which the presence of the rarer or simpler vapours is determined.

Nor is this all. Not only have lines been seen, but their positions have been determined with some degree of accuracy, although it must be pointed out that the opinions of authorities do not coincide as to the actual materials indicated or as to the interpretation to be put upon the observations. This is not to be wondered at, considering the amazing delicacy of the research and the few opportunities there have yet been of making perfectly satisfactory determinations.

The most searching criticism of the results hitherto obtained appeared some little time ago in *Poggendorff's Annalen* from the pen of Dr. Vogel (NATURE, vol. ix. p. 193), and it will be well to briefly glance at some points which result from his inquiry. Donati, in the first observations of this nature made in 1864, determined the existence of three bright bands, but made no attempt to determine the substance from which the light proceeded. Huggins in 1866 made the first attempt in this direction, and came to the conclusion that, like the nebulæ, the comets might be composed of nitrogen, as in the spectrum of the comet visible in that year there was a single line which nearly, if not quite, coincided with one of the brightest lines of that element. In 1868, however, the idea of nitrogen comets was abolished, as the idea of nitrogen nebulæ has been since; and the three bands, which were again observed in the comets visible in that year, were found to coincide with those of olefiant gas. Hence it was suggested by Huggins that they consisted of carbon vapour. He writes:—"The great fixity of carbon seems indeed to raise some difficulty in the way of accepting the apparently obvious inference of these prismatic observations. Some comets have approached the sun sufficiently near to acquire a temperature high enough to convert carbon into vapour. Indeed, for these comets a body of great fixity seems to be necessary. . . If the substance of the comet be taken to be pure carbon, it would appear that the nucleus had been condensed from the gaseous state in which it existed at some former period. . . . If we were to conceive the comet to consist of a compound of carbon and hydrogen . . . other difficulties would arise in connection with the decomposition we must then suppose to take place . . ."

It is clear that Mr. Huggins' opinion is that a comet consists of carbon; that the vapour is carbon vapour driven into incandescence by a temperature high enough to volatilise carbon, and not the vapour of a volatile hydrocarbon.

Such is not M. Vogel's view, and I confess it is not mine. After giving details of the observations of the nine comets examined between 1864 and 1871, M. Vogel thus analyses them :—

> "Of these nine comets, there is only one (1870) for which we have no observations as to the position of the bright bands. Of the remaining eight, the spectra of five (1, 2, 4, 7, and 9) have shown *no* agreement with the hydrocarbon spectrum. As regards the Comet II. 1867 the supposition is offered that its spectrum was similar to the spectrum named; as to Encke's Comet III. 1871, it remains uncertain in which class it is to be reckoned (Huggins' observations being at variance with those of Young and myself). There remains only the Comet II. 1868, for which Huggins' and Secchi's observations assert a probability of coincidence of the lines in its spectrum with those in the spectra of volatile hydrocarbons.
>
> "It thus appears a somewhat questionable view, that the comets consist of such matter; and we should, I think, content ourselves with the deduction that a portion of the light emitted by the comet is its own light, and very probably from glowing gas."

Hence, then, the whole question of the true material of which that part of the comet consists, the spectrum of which has been already observed, must be acknowledged as being still *sub judice*: and this is a matter of the first order of importance, on which the present comet may throw much light.

But one of the most hopeful points is this: the comets up to the present time have been either so small or so distant that the record of aigrettes or envelopes on the spectrum has not been determined; nay, the comets might have been deprived of those appendages, hence the statement concerning the spectrum is a very general one; there has been no sufficient opportunity of localising the spectrum-giving region or regions.

What a glorious harvest will be reaped should the jets appear as decided as in the comet of 1861, or in Halley's comet at its return in 1835; "jets, as it were, of flame, or rather of luminous smoke, like a gas fan-light," which, as described by Sir John Herschel, "varied from day to day as if waving backwards and forwards, as if they were thrown out of particular parts of the internal nucleus or kernel, which shifted round, or to and fro, by their recoil, like a squib not held fast."

Or again, suppose the system of concentric envelopes is developed to the same extent as in Donati's comet, in which the action at all points of the nucleus, to follow Sir John Herschel's reasoning, was probably more general, a result due to a more uniform chemical constitution.

Hence the comet may leave us a rich inheritance in the shape of "spectrum of jets," or "spectrum of envelopes;" and from what I have already seen dimly (for such observations are beyond my instrumental power), the former is the more probable, and in the nucleus we may have the equivalent of the sun, or the carbon pole of an electric lamp, with a continuous spectrum, and in the jets phenomena identical with those presented by solar storms, or the electric arc, that is, lines of various lengths indicating various vapours, shooting out or extending to various distances according to their volatilities, or vapour densities.

We seem, indeed, to have got a true physical approximation to this state of things in the comet of 1868, for Mr. Huggins observed that while some of the lines thinned out as one sees them do in the ordinary spark by using a lens, quite independently of the general visibility of the vapour, others did not so thin out, but retained their breadth till they disappeared altogether.

The extent to which this action will go on will obviously depend upon two things, first the temperature and secondly the materials of the comet; and this raises an important question, which perhaps is easier of solution than the determination of the materials ejected, should that phenomenon be spectroscopically recognisable.

I have already communicated to NATURE the fact that to me the continuous spectrum of the nucleus appears deficient in blue rays. The effect of this upon the colour of the nucleus would be to give it a yellowish tinge like that of a candle flame, and for the same reason.

Dr. Vogel, in the paper to which I have already referred, deals with this question of colour, stating that :—

> "Dr. Zenker arrives at the conclusion that there must be water-vapour in the comets; since they have, according to Schmidt, a yellowish-red colour, and the sun's rays, when they pass through a considerable thickness of aqueous vapour, are coloured thus. But apart from the consideration that sunlight has a yellowish-red colour on passing through other vapours as well as aqueous, I would remark that we must take the proper light of the comet, which appears from spectral analytic observations to be generally more intense than the reflected light, as determining its colour. According to the observations made, we should expect that the comet is, on the whole, of greenish or greenish-blue colour, since all the spectra consist, as we have seen, of two or three bands of light, of which one is in the yellow, the second and brightest in the green, and the weakest in the beginning of the blue. Of the (generally very faint) continuous spectrum, only the brightest part—yellow, green, and commencement of blue —is visible. The entire image, therefore, even where the weak continuous spectrum appears, will seem of greenish colour. Colour-data have been furnished by other observers besides Schmidt; and the head of the Comet 1811, *e.g.* had, according to Herschel, a greenish or bluish colour; the nucleus was slightly red. The colour of Halley's comet, at its return in 1825, was a bluish-green (Struve). Winnecke says of the comet of 1862, 'The colour of the neck appears to me yellowish; the coma has bluish light.'"

It will be seen that these remarks are quite in accordance with the suggestion. Dr. Zenker attributes to absorption the effect which I ascribe to defective radiation, and if it should be determined that the spectrum of the nucleus is truly deficient in blue rays, then a great point will be gained, *for its temperature must be low.*

Angström, whose death the world of science is now deploring, lived to say that he conceded that different molecular arrangements of the same element might give us different spectra; and Roscoe and Schuster have recently placed beyond all doubt that, besides the well-known high temperature spectra of sodium and potassium, there are other spectra appertaining to the vapour of these elements at a lower temperature.

Now these spectra are *channelled-space spectra*, that is similar in character to the spectrum which has already been observed in the case of comets; and if such spectra be obtained for all elements (and I have already added to the list), if a comet be a body at a low temperature, it is such spectra as these that we shall see, and not line spectra. Further, in the case of compounds in which the molecules which give us these new spectra enter into combination, we may possibly dissociate them and observe their spectra at a much lower temperature than we can drive the higher molecular arrangement of the solid into vapour,

Such considerations as these derive additional interest and importance from the beautiful researches of Schiaparelli, which connect comets with meteorites.

Modern science acknowledges that comets are individual members of meteor swarms—not that meteors are comets' tails, as some think; this idea is, one may say, impossible to reconcile with facts—that one difference at any rate between a comet and a meteor is that one is self-luminous, the other is not till it arrives within the limits of our atmosphere. If this be acknowledged, then to what is this difference to be ascribed? A possible cause is certainly a difference of chemical constitution—a difference between materials incandescent at a high temperature and materials incandescent at a low one. It is not necessary to stop to inquire how this temperature has been arrived at, but it is important to show that the question of temperature is one of the very first points to be attended to by those who can bring sufficiently powerful instruments to bear upon the present comet, and that the question of its actual chemical constitution is bound up with it.

But whatever be the temperature of the head there is another point which must not be lost sight of. Sir John Herschel writes concerning Halley's comet: "The bright smoke of the jets, however, never seem to be able to get far out towards the sun, but always to be driven back and forced into the tail, as if by the action of a violent wind rolling against them—always from the sun—so as to make it clear that this tail is neither more nor less than the accumulation of this sort of luminous vapour, darted off in the first instance towards the sun, as if it were something raised up, and as it were exploded by the sun's heat, out of the kernel, and then immediately and forcibly turned back and repelled from the sun." Here we have the question raised not only whether the envelopes consist of different materials, but whether the tail is not entirely or in part self-luminous: the present comet may show that this point is not so satisfactorily settled as it is supposed to be in favour of reflected light.

Such then are briefly some of the questions at issue. It is to be hoped that our beautiful visitor will answer some of them for us, and that when it leaves our northern skies the work may be carried on in the southern hemisphere.

J. NORMAN LOCKYER

THE CHANNEL TUNNEL

WE fear there are still many who fail to see that any good can come of scientific research unless it has some well-defined "utilitarian" object in view. Even in this and in other countries that are in the van of civilisation and in which education is comparatively wide-spread, the majority of mankind can appreciate a benefit only when it takes a concrete and tangible form. That love of knowledge for its own sake, that noble inquisitiveness which has been so fruitful in results during the last two hundred years, even yet belongs to comparatively few, who are still regarded by the many with a kind of impatient pity as mere unpractical hobby-riders. Still the people who talk in this way are proud enough of the glory which their great men have shed upon their country, and would not willingly, we believe, part with it for money were this possible; and indeed how would this country appear among the nations were she deprived of the inestimable inheritance which her great sons have bequeathed to her in every department of intellectual activity? Happily, however, the race of those who decry single-eyed scientific research is getting sensibly smaller; and we firmly believe that as education improves and as higher education spreads, carrying with it the results of this same scientific research, it will disappear.

Still, a little consideration might show those who are ever ready to cry "what's the good?" that since all so-called "practical" schemes are concerned either with man's own body or with the surrounding universe, an essential part of the basis of any scheme is a thorough knowledge of the material on which it is proposed to work. Such a knowledge it has over and over again been shown is only to be attained by abstract scientific research, by investigation conducted as if the only end in view were a thorough knowledge of the subject in hand in all its scientific aspects and relations. Many instances could be given, and indeed are every day occurring, of the highest practical results unwittingly following from such investigations; and to the sceptic we could not recommend a better example of how indispensable is thorough scientific research as a basis for the useful arts than the results of the investigation into the geology of the Channel which Mr. Prestwich (the newly elected Oxford Professor of Geology) presented to the Institution of Civil Engineers last December, and which, with the subsequent discussion and maps, has just been published in a separate form. This study of the strata which underlie the Channel, and which seems to us an almost perfect example of close and careful reasoning on physical facts, is now brought forward to enlighten the projectors of a tunnel between England and France as to the nature of the material with which they will have to work; but Mr. Prestwich distinctly states that the various formations are considered "irrespective of their relative merits in any other than a geological point of view."

Mr. Prestwich's plan is to discuss carefully all the strata which underlie the Channel, from the London clay down to the Palæozoic series, exhibiting distinctly their lithological characters, dimensions, range, and probable depth, and from these data deducing his conclusions as to the suitability of each formation for being pierced by a tunnel. The investigations of himself and others on which Mr. Prestwich's paper is founded were mostly undertaken from no practical point of view, and before a Channel tunnel was thought of. Mr. Prestwich, many will be glad to think—grateful, we hope, at the same time for this very practical result of pure scientific research—concludes that from a geological point of view it is quite practicable to construct a tunnel underneath the Channel, although to do so with safety it will be necessary to go very deep down. But an excellent idea of the results of the investigation will be obtained from the following clear summary with which Mr. Prestwich's paper concludes:—

"In the London clay there exists a perfectly impermeable bed of sufficient thickness, but nowhere between the two countries, except probably at points where the distance presents apparently insuperable difficulties. The lower chalk or chalk marl affords a comparatively impermeable deposit, also of sufficient dimensions: but from its having a calcareous base, and from the possibility of fissures, with the absence of a protecting overlie, it has great uncertainty. In the gault there is another impermeable stratum, but of dimensions too small. The lower greensand contains no beds sufficiently continuous and impermeable. The Weald clay ranges about half-way across the channel; and if a belt of it should possibly pass round at the north end of the Varne and range to Wissant, it might prove to be worth further inquiries. In the Kimmeridge clay there is again a deposit of sufficient dimensions, but with a subordinate band which may be sufficiently permeable to present difficulties, whilst, though it comes to the surface on the French coast, its depth on the English coast must be very considerable. There is, however, just a chance that the Kimmeridge clay may in mid-channel be overlapped unconformably, and at a slight angle, by the Weald clay, and in that case they might for all purposes be considered as continuous strata. The Oxford clay presents similar difficulties, in addition to its greater depth and inaccessibility. In the secondary strata the irregular lie of the strata, and the presence of faults, are contingencies important to be considered.

"On the other hand, the great mass of the Palæozoic rocks so protected by impermeable overlying strata, is of such great dimensions, and so compact, and holds its range so independently of the more irregular range of the secondary strata, that it offers the conditions most favourable for the secure construction of a submarine tunnel; and that such strata can be worked in safety and for considerable distances under great bodies of water, has been proved at Whitehaven and Mons. But, on the other hand, the depths of these old rocks below the surface is very great, and they are much more dense and harder than the overlying formations.

"There is another important problem in connection with the Palæozoic rocks which such an undertaking might help to solve. The great question of the range of the coal measures under the south of England has lately come prominently into notice; and it was, in fact, in inquiries connected with that question that the foregoing considerations presented themselves to the author. The rich coal basin of Mons and the north of France has been traced to within thirty miles of Calais, where it thins out; but, like the coal basins of Liege, Aix, and Westphalia, which form separate sections of the same great trough, to the eastward, so there is reason to suppose that other sections of the trough set in on the westward, forming other coal basins, which possibly range to the west of England (Somersetshire), passing under the north-eastern part of Kent and the Thames. Any such work, therefore, as a submarine tunnel in these Palæozoic rocks could not fail to throw much light on the subject; while, in case it were to hit upon the line of strike of the coal measures, and could be carried on along that line, the work might prove otherwise remunerative, and tend to solve the great problem which interests so largely both geologists and the general public.

"Such, briefly, are the conditions which bear on the construction of a submarine tunnel between France and England. The author is satisfied that, considered on geological grounds alone, it is in one case perfectly practicable, and in one or two others it is possibly so; but there are other considerations besides those of a geological nature, and whether or not they admit of so favourable a solution is questionable. In any case the author would suggest that, the one favourable solution admitted, it may be desirable, in a question involving so many and such great interests, not to accept an adverse verdict without giving all those other considerations the attention and deliberation which the importance of the subject deserves.

"Under any circumstances, the difficulties are formidable. Whether or not they are insuperable are questions which may safely be left to Civil Engineers. The many and great obstacles overcome by engineering science in late years lead the author to expect that, should the occasion arise, and the attempt be considered worth the cost, the ability to carry it out would not be wanting. Various preliminary trials are, however, indispensable, in order to clear up some of the geological questions before a balance of the comparative advantages presented by the different formations could be satisfactorily settled, and before the grounds for action could be accepted."

From this it will be seen that the possibility of a Channel Tunnel remains now only with the engineers to decide. Geology has told them all the natural conditions under which they will have to work, so far as these can be known without actually tunnelling; and since so cautious a reasoner as Mr. Prestwich thinks it possible to carry out the scheme from a geological point of view, we should think that if it could be proved that the undertaking would pay, our engineers would be eager to show that the resources of their art are quite equal to its successful accomplishment.

OWENS COLLEGE "ESSAYS AND ADDRESSES"

Essays and Addresses. By Professors and Lecturers of the Owens College, Manchester. (London: Macmillan and Co., 1874.)

THIS book is due to the natural desire of the teaching staff of the Owens College to have some memorial of an event of the first importance in their own history, and to give expression to the hopes that animate the institution. The Owens College was founded by a single legacy a quarter of a century ago—for the creation of a college in which Lancashire lads might study at home the "branches of learning commonly taught in the English Universities." It first became known in connection with its first Principal, Scott, a writer who has left nothing which explains the high rank he held among his contemporaries and especially the influence he unquestionably exercised over every young man with whom he was brought into contact. Under him, however, the College did not flourish—the number of the day students sank at one time as low as 25—and it was only after the appointment of the present Principal, Dr. Greenwood, that it began to take root in Manchester. It has now about 350 day students—not including the medical students, who have been added only this session—and nearly 800 evening students. Curiously enough, what happened in Glasgow to the disappointment of many of the well-wishers of the University, happened also in Manchester. When the new buildings, with all their increased convenience for study, were opened, it seemed natural to anticipate a great increase of students. Nothing of the kind took place. Students seem to come and go to college because they want to be taught, not because they are to have beautiful buildings to be taught in. The effect will certainly be considerable, alike on teachers and on taught, of the more commodious buildings recently erected in Glasgow and in Manchester, and it will be felt more and more as time goes on. The fact that it is not felt at first shows, however, that the wants that are satisfied by university teaching lie so deep down that an external event like the inauguration of new buildings scarcely influences them.

The success which the Owens College has thus attained in a quarter of a century is due to much hard work—to careful and deliberate adaptation not merely to the wants of the time, but to the claims of real culture—and above all of course to the fact, which that success proves, that in Lancashire, or that portion of it of which Manchester is the capital, there is a real demand that the higher education may be brought home even to the doors. This book serves as a record of much of the work done—and an expression of the ideas of the teachers whose spirit has made and still makes the Owens College. No one who glances at the titles of the fourteen essays and addresses of which it consists can fail to be struck with the variety of the teaching. It accomplishes the task laid upon it by its founder, by teaching nearly everything commonly taught in the English Universities. We find two Professors of Classics, one of Oriental Languages and one of Modern Languages, two of Natural Philosophy, a Professor of Natural History, and a teacher of Geology, a Professor of Chemistry, a Professor of Engineering, a Professor of Jurisprudence and Law, a Professor of Physiology, and two gentlemen who seem to be three or four Professors rolled into one, the accomplished incumbents of the chairs of "English and History," and of "Logic, and Mental and Moral Philosophy, and Political Economy." Besides these, there are at least half a dozen more, the Professors of Mathematics, the Professors of three or four Medical subjects, the additional lecturers on Law, on Organic Chemistry, and so on, who put in no appearance in the volume. The College is in fact equipped with a staff of teachers which bears favourable comparison with that which is usually found in older Universities. The Medical department has been added only this session; the Law and Jurisprudence department has recently made a considerable step in advance. Except that several of its members are evidently overburdened with subjects too large for any single man, the staff of the College is reasonably complete, and most things can be learned in it which are taught elsewhere.

We turn with interest to the volume before us to discover, in the choice of their subjects and in the manner of treating them, the aims and tendencies of the professors and lecturers. What is most noticeable, and it cannot fail to strike even the casual reader, is the caution, the moderation, we had almost said the conservatism which is characteristic of most of them. People are still tempted to associate the name of Manchester with everything that is "advanced," and we look in such a book as this for a daring championship of educational and scientific novelties. From the first words of the President's opening address to the last words of the essay which closes it, the tone of responsible thoughtfulness, of the wish to be just and true more than to be vigorous or startling, is never to be mistaken. The Duke of Devonshire the President, and Dr. Greenwood the Principal, unite in urging that the older class studies—those connected with literature—should not be pushed aside and comparatively disregarded, and that the newer studies should be taken up in their full depth and breadth, not in a fragmentary or superficial manner or with any supposed reference to their immediate application. These cautions are supplemented, indeed, but they are not contradicted, by Prof. Roscoe and Balfour Stewart, who urge, the one that original research is a powerful means of education, and that original research should be organised, as it has already been to some extent, especially in his own department; the other that we should set about great national studies, establishing a watch, for instance, on the sun, "a creator of disturbances on the greatest possible scale, who is ever ready to afford us information about himself at the smallest possible cost." Mr. Reynolds follows them with a demand for a national commission to experiment on heat engines, and the conditions under which they could be practically worked, economically, or efficiently, or both, to higher pressures than we now attempt to use, so as to get more work out of our coal and our machinery, and perhaps some day to enable a lightweight jockey to fly at the rate of 200 miles an hour. After these speculations and demands, which are certainly significant of the modern age, follows Prof. W. C. Williamson's cautious and copious discussion of the theories of natural selection and evolution, as tested by primeval vegetation. We call it a conservative paper because the conclusion of the writer is that among the innumerable facts known and co-ordinated about the primeval vegetation, there is little sign that the laws of natural selection and evolution have operated to a large extent in transforming the vegetable species of the pre-carboniferous strata to those with which we are now familiar. But Prof. Williamson is absolutely frank in his admission of the new laws, and singularly candid in accepting any explanations which they seem to offer. He admits "that by the help of natural selection man has brought into existence many new varieties of pre-existing plants and animals, most, if not all of which, were his protecting hand withdrawn, would soon revert to their primal forms. We have no evidence that unaided nature has produced a single new *type* during the Historic period. We can only conclude that the wonderful outburst of genetic activity which characterised the Tertiary age was due to some unknown factor, which then operated with an energy to which the earth was a stranger, both previously and subsequently." It is in a bolder spirit that Prof. Bryce speaks of the new Judicature Act, a measure which throws us back in principles and in practice many centuries, and which is, in his view, "a reform in English law greater in some points of view than we have had since English law itself began to exist." The note of conservative caution returns on our ears in the two last essays on the Relation of the Railways to the State, by Prof. Jevons, and on the Peace of Europe, by Prof. Ward. The conclusion of the former is emphatic, and altogether hostile to the movement party who advocate the State purchase of our railway system. There are few questions deserving to be more seriously studied by politicians or likely to need more serious study, for in the changes and chances which affect our governments, some new men may some day drift with us into schemes which would be in themselves imprudent, and which would be foolish except by way of preface to a more comprehensive measure. We could not take the railways over, Prof. Jevons thinks, for less than a thousand million sterling, which is about double their commercial value. The attempt might be all but ruinous to the nation, and the results would be altogether disappointing. But among the middle and upper classes, who own the railways, there is certain to be a considerable feeling in favour of a scheme which would be fruitful of so much pecuniary benefit to themselves, [and it is well to have it discussed beforehand as thoroughly and as thoughtfully as it is discussed here. It is in useful conservatisms such as these that Universities often do their greatest services. They are mints at which the coinage that is passing current in the commoner exchanges of the world may be thoroughly tested. Prof. Jevons offers statesmen and politicians an admirable discussion, luminous with the most practical good sense. Like his colleagues, Prof. Ward is conservative in the sympathies of his essay. We have been engaged for many years in breaking down the venerable theory of the Balance of Power in Europe, and we have been attempting to build up in its stead a sort of Temple of Doctrinairism—sacred to a goddess of international arbitration, who is to be capable of the cure of all international ailments. Prof. Ward applies the touchstone of his comprehensive historical knowledge to both. He is utterly hostile to the doctrine of Spinoza that, as the natural state of man is a state of war, no nation is bound to observe a treaty longer than the interest or danger that caused it continues. But the old treaty basis of the peace of Europe having broken down, "the remedy for the danger accruing with new force to the peace of Europe is to be sought, not in an abandonment of the principle of joint action, but in an enlargement and elevation of it, and in the progress of that enlightenment which, instead of enfeebling, strengthens the common action of men and of states. For it is with nations as with individuals. The cultivated, and by culture enlightened, mind is and must be on the side of progress and peace against that of darkness and conflict. The obscure men, like the unformed nationalities, are at once materials and causes of that which disturbs, unsettles, and retards personal and national and international life. Where the education, and more especially the higher education, of a country is fostered, there lie the best promises of progress and of peace."

We do not attempt any detailed criticisms of the several essays. The subjects chosen by fourteen professors on which to address the world are likely to be reasonably well chosen, and the addresses delivered on them are pretty sure to reward the attention of the reader. They strike us as very well chosen; they sufficiently represent the real variety of teaching and of manner of teaching in the institution; they contain complete and occasionally brilliant discussions of subjects of very considerable general interest. They are the expressions of the inner spirit of a seat of learning in which science holds a higher place than she has usually done, but in which there is the most emphatic and continual protest against the degradation or neglect either of literature or of science. They show a body of teachers full of modern life, and at the same time singularly moderate, truthful, and reverent. Several of the essays are historical studies, and in these cases the reputation of the writer is a sufficient guarantee of completeness. In their collected form the "Essays and Addresses" warrant high hopes of the future of the Owens College. In a sense—perhaps a somewhat too literal sense—it is what it was once called in a journalistic epigram, the University of the Busy. With its present staff it will certainly continue the tradition which connects the older Universities with the highest learning of the time.

W. J.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Sir John Herschel's Letters

It is known to many through the numerous applications I have made, that a collection of the letters of Sir John Herschel is in progress. For the many and valuable contributions, as well as for the kind and sympathetic expressions which I have been favoured with, I cannot be too ready to express once more my sincere acknowledgment; and when I recall these to mind I hesitate to take any less private step to further the end in view, or, by venturing on a public appeal, to forego the advantage of more direct communication. Several considerations however—which not even your courtesy in allowing this letter to appear in the columns of NATURE would justify me in dwelling upon—forbid me to depend solely on the activity of a single importunate pen. The correspondence in question covers more than half a century. Many of the correspondents were of a former generation, and their present representatives are known to but few. I may instance the names of Davy, Young, Wollaston, —not to mention many continental savans—in illustration of this. Many others, less eminent, but not the less recipients of letters which the student of scientific history will prize as containing the germs of much of the force whose impetus we now feel, were hardly known by name beyond their own immediate circles. Many more, as I would fain believe, who either themselves corresponded with my father, or knew him in his letters to their relations, are even now in possession of such letters, and may not be unwilling to let them be seen. Lastly, I hear too much of autograph collectors not to feel a keen desire to make their instant acquaintance. Have they not devoted themselves to preserving individual letters, no matter how trifling, from the fate which has—alas too often—overtaken others, no matter how numerous, or how valuable!

In my applications hitherto I have been constrained to repress the expectation of immediate publication. I am not at liberty to depart from that now. But that the materials which I may now be permitted to store up *will* eventually help to form the foundation of such a monument as may be fitting—this requires no student of history to tell us. That it may be amply provided for now, before it is too late, is my chief anxiety. For my time is limited, and I have drawn too many blanks not to feel that every year increases their number, let who will take my place.

I apologise for so long a story, and will only add in the most general terms that I appeal to all who possess, or know of the existence of, autograph letters of Sir John Herschel—no matter how insignificant they may seem, for collation with others can alone supply a true test—but of course with due regard to personal consideration—to communicate with me at once. It is hardly necessary to say that all autograph letters will be returned, and that any restrictions will be attended to.

21, Sumner Place, Brompton, S.W.

J. HERSCHEL

Coggia's Comet

YOUR readers may be interested to learn that the light of the comet is by no means strongly polarised. On the 2nd and 4th instant I examined it with a double-image prism, but could not with certainty detect any difference between the brightness of the two images. I also examined it with a plate of right- and left-handed quartz in the principal focus of the 4-inch telescope and a Nicol's prism packed among the lenses of the eyepiece, but could not detect any traces of colour. With a Savant placed between the eyepiece and the eye no bands were detectable. But on the 6th, about midnight, when the comet was shining very brightly, I could perceive a difference in the brightness of the two images with the double-image prism, indicating polarisation *in* the plane passing through the sun's estimated place. But I was still unable to detect any traces of polarisation either with a Savant or Biquartz, or with a plate cut from a natural crystal of right- and left-handed quartz giving a band across the field in which the two crystals overlap; a form of polariscope which has been found on other occasions very delicate for faint lights.

If the tail of the comet consisted of a *fine* dust not in a state of incandescence reflecting or dispersing the sun's rays, we should expect its light to be completely polarised. We seem, therefore, driven to assume, either, 1, that the tail consists of fine incandescent particles; or, 2, of particles whose diameter is not small compared with the wave-length; or, 3, of incandescent gas; or, 4, possibly of all three of these states combined.

A. COWPER RANYARD

Photographic Irradiation

IN a letter to NATURE, vol. ix. p. 183, I gave a short description of some experiments on photographic irradiation. The conclusion to which these experiments pointed was that there is a kind of photographic irradiation, caused either by the bright light producing an intense state of chemical activity, which has the power of extending itself in every direction; or what seems more probable, the parts of the collodion on which the bright light is falling become luminous and reflect light to the surrounding parts of the sensitive film, and thus extend the chemical change on each side of the true optical boundary line. As the subject is at present under discussion, I send you the results of the following experiments, which seem to support the above conclusion. In a darkened room a vertical opening 18 in. by 5 in. was made in the shutter; over the opening was fixed a piece of paper thick enough to stop most of the light, and only allow as much to pass as would give a decided but not deep photographic impression. Three long, narrow, parallel openings were cut in the paper, one opening was left clear to the sky, the next was covered with one thickness of tissue paper, and the third with two thicknesses of tissue paper. There was thus produced three parallel bars of different brightness on a uniform and darker ground. Sensitive wet plates were prepared in the usual way on glass and opaque black plates; across the front of the plates, and almost in contact with the collodion, was fixed a horizontal bar of thin blackened metal in such a position that it would cross the image of the luminous bars in the camera. The photographs, after exposure, were developed in the usual way, and it was found that the shadow cast by the horizontal opaque bar was not bounded by straight lines, but the ends of all the bright bars projected into the shadow, and the brighter the bar the farther it projected. I had no means of measuring accurately the bar and its shadow, but there seems but little doubt that the bright bars extended underneath the opaque bar, whilst the edge of the darker ground at the side of the bright bars gave the correct line of the shadow. Now this extension of the bright bars could not have been caused by the reflection from the back of the plate, as this result was always got whether glass or opaque black plates were used. Nor could it have been caused by the oblique pencils referred to by Lord Lindsay and Mr. A. C. Ranyard, because, the opaque bar being close to the collodion, these pencils could not get underneath. The natural conclusion seems to be, that this extension of the bright bars must have been caused by some molecular reflection taking place in the collodion. This form of irradiation can easily be distinguished from the irradiation produced by reflection from the back of the plate, as the latter is simply a sort of haze surrounding the bright object, extending some distance from it, and gradually fading away, whilst the former extends a very short distance and has a well-marked outline, though not so sharp as those parts of the image where there is no irradiation. The irradiation produced by reflection from the back of the plate, and some forms of irradiation due to the imperfections of the lens, though fatal to artistic photography, yet do not interfere much with its scientific value, as they do not affect the accuracy of outline, though they do affect the clearnesss of the photograph. Molecular irradiation, on the other hand, whilst it scarcely affects artistic photography, is fatal to scientific accuracy. The manner of preventing this latter form of irradiation has been already pointed out, namely, by reducing the intensity of the light falling on the sensitive surface to only that necessary to produce a distinct impression. In artistic photography this is almost never possible on account of the different amount of light on the different parts of the subject, while for scientific purposes this may almost always be done. The imperfections of the image due to the lens seem to be as various as the forms of lenses; one lens used in the experiments gave a curious double hazy-image of the bright object. When the image is near the centre of the "field" the double image fits over the true image, producing an effect somewhat similar to, and was at first mistaken for the effect of reflection from the back of the plate. At first this double image was somewhat puzzling, as it always made its appearance even when opaque plates were used. The two images were, however, afterwards separated by bringing the true image near the outside of the "field," when the true image and its double were photographed alongside of each other.

The following simple experiment illustrates this molecular form of irradiation, and shows how much the definition of the image depends on the nature of the surface which receives it. Take a camera obscura and throw the image on some translucent substance such as opal glass; paint a small part of the glass with some opaque white substance; bring into the "field" some brilliantly illuminated subject, such as branches of trees against the sky; examine the image from the lens side of the glass, when it will be found that the image over the opal glass is hazy and indistinct, whilst the part of the image on the paint shines out brilliant and sharp.

JOHN AITKEN

Darroch, Falkirk, N.B. June 16

Lakes with two Outfalls—A Caution

LLYN CREIGENEN (the larger of the two lakes of that name), situated about five miles S.W. by W. of Dolgelly, has *apparently* two natural outlets—one at the east, the other at the west end of the lake; both streams ultimately fall into the estuary of the Mawddach. The two outlets are on nearly the same level, the one at the east end being perhaps a trifle higher than that at the west end. The whole of the waste water at present passes through the western outlet in consequence of an artificial dam of turf having been made across the eastern channel. There are no indications on the ground which would lead anyone to suspect that either of the outlets had been artificially formed; the general contour of the surrounding country would rather favour the contrary view.

I was, however, informed last week by a man who had lived eighteen years in the district *that he had been told* that originally the only outlet was that at the west end of the Llyn, and that the other outlet had been made many years ago for the purpose of getting a better supply of water to some mills which then existed, but which do not now exist, on the stream to the east of the lake. If this story prove to be correct it shows how important it is to make full inquiries before stating positively that any lake has two natural outfalls.

From the ordnance map one would imagine that two streams issued from Llyn Arenig (five miles W.N.W. of Bala), but the one shown as starting from the extreme north end of the lake has no existence in fact.

GEORGE R. JEBB

Chester, June 3

FERDINAND STOLICZKA, PH.D.

A BRIEF telegram from India, which arrived just in time for notice in last week's NATURE (vol. x. p. 172), announced the death on the 19th ult., at Shayok, between the Karakorum Pass and Leh in Ladak, of Ferdinand Stoliczka, Palæontologist to the Geological Survey of India, who was returning from Kashgar and Yarkund with the other members of Mr. Forsyth's mission.

Thus has passed away, at the early age of thirty-six, a naturalist who, if his life had been spared, would certainly have attained a very high position amongst the leaders of science. Few men have accomplished an equal amount of work in the same brief space of time. A glance at the Journal and Proceedings of the Bengal Asiatic Society, and the publications of the Geological Survey of India, especially the "Palæontologia Indica," will show the wonderful variety of subjects treated by Dr. Stoliczka. In the course of the last ten years, besides geological memoirs on parts of the Western Himalayas and Thibet, he has published numerous papers on Indian mammals, birds, reptiles, amphibia, mollusca, bryozoa, arachnida, coleoptera, and actinozoa; and these papers are no lists of names or mere descriptions of new species, but they abound with accounts of the life history of the different animals, details of their anatomy, and remarks on classification, and show that their author was as good an observer in the field as he was patient and accurate in the cabinet. His greatest work is undoubtedly his account of the fossil fauna discovered in the Cretaceous rocks of Southern India, in which he proposed the most complete general classification of Gasteropoda and Pelecypoda (Lamellibranchiata), *including both fossil and recent forms, which has hitherto been attempted. This classification* was largely supplemented by original anatomical research, and it has been adopted in one, at least—we believe in two—of the principal museums in Germany.

Dr. Stoliczka was born in Moravia in May 1838. After completing his university course he joined, whilst quite young, the Imperial Geological Institute of Austria, where he soon distinguished himself by his palæontological work, and became especially known for researches amongst the Bryozoa, fossil and recent. The collection of specimens belonging to that class obtained by the Novara expedition was intrusted to him for description. Amongst his principal early contributions to palæontology were papers on the fossil fauna of the Hierlatz and Gosau beds.

In 1862 he joined the Geological Survey of India, and at once commenced the study of the magnificent series of Cretaceous fossils obtained by Messrs. H. F. Blanford, C. Oldham, and the other officers of the Survey engaged in the Madras Presidency. The descriptions of these fossils have only recently been completed, and extend altogether to about 1,500 quarto pages illustrated by 178 plates. There can be no doubt of the rank of this work; it is one of the most complete monographs ever published of any fossil fauna whatever. The numerous duties connected with the post of Palæontologist to the Survey occupied so much of Dr. Stoliczka's time that he was only able to devote a few months in three different years to field-work. To this field-work we owe valuable reports on the western Himalayas, Thibet, and Kachh, the last not yet published. In the year 1868 he accepted the honorary secretaryship of the Asiatic Society, and during the five years he held the post he raised the natural history portion of the Society's journal to a position it had never approached before, this improvement being due no less to his own contributions than to the aid he was always ready to afford to all engaged in zoological inquiry.

When, last year, a mission was despatched by the Indian Government to Yarkund and Kashgar, Dr. Stoliczka was selected to accompany it as naturalist and geologist. It would have been impossible to have found anyone more competent for the post, but many of his friends knew the risk he ran, and he was well aware of it himself, for his health had been seriously affected by exposure in former years in the higher regions of the Himalayas, and he needed rest and a change to Europe. His life has been a sacrifice to the study to which he had devoted it. He was seriously ill at one time when crossing the high passes on his way to Yarkund, but recovered, and his letters from Kashgar gave glowing accounts of his discoveries, and now when returning loaded with the spoils and notes of nearly a year's research in one of the least-known parts of Central Asia he has fallen, just as his friends were in hopes of welcoming him back amongst them. This is not the place to speak of his many amiable qualities, but few men were more widely known in India or more universally beloved and esteemed, and the gap he has left in the little band of Indian naturalists and geologists, as well as amongst the far wider circle of his private friends, will be long unfilled. W. T. B.

OBSERVATORIES IN THE UNITED STATES

ONE of the most salient points in the scientific progress of America is undoubtedly the marvellous multiplication of first-class observatories during recent years. The genius of her people, the skill of her artists, and the wise liberality of states and individuals have combined to bring about a state of things which those interested in Astronomy in any country on this side of the Atlantic may regard with the intensest envy. Undoubtedly our own observatories are already distanced in everything except activity. In number, instrumental equipment, breadth of design, the American institutions are unsurpassed; and although the Americans themselves say they want men with such world-wide names as Peirce, Winlock, Newcomb, Young, Peters, and many others that we might mention, who know no resting on old laurels, it is difficult for an Englishman to acknowledge that the idea is well founded.

A very interesting and well-illustrated article on United States Observatories appears in a recent number of *Harper's Monthly*. Some of the illustrations, which we are enabled to give by the courtesy of the Editor, give a good idea of the scientific wealth to which we refer, and of the progress that has been made, for while little more than thirty years ago it could not be said that there was one astronomical observatory in the United States, to-day it is safe to place the number of all classes, public and private, beyond fifty.

Cincinnati Observatory.—One of the most strenuous advocates for the establishment of public observatories in the United States was John Quincy Adams, who had made astronomy a favourite pursuit. He had very just conceptions of what ought to be the character and aims of a true observatory. It must steadily labour for *discovery*. It must be fully equipped for this, and be provided with a *personnel* who could give their whole energies to that series of observations, running through many years, which alone can secure valuable additions to astronomical knowledge and insure its benefits to men. For the establishment of such an institution he had made his well-known appeal to Congress in 1825. He was ridiculed; but he remained as strenuous an advocate as ever for the establishment of observatories of the first class both at Washington and at Cambridge. In the very year before this address at Cincinnati he had urged, in his place in Congress, the perpetual appropriation of the whole interest of the then unappropriated Smithsonian fund for an observatory for the people.

"The express object of observatories," said he, "is the increase of knowledge by new discovery. It is to the successive discoveries of persevering astronomical observations through a period of fifty centuries that we are indebted for a permanent standard of time and for the measurement of space."

The year 1843 was, however, an era in the history of United States observatories, and Cincinnati was their birthplace. Her institution and those of Cambridge and Washington sprang up, and the enthusiasm of the era started others, whose equipment has been secured largely by their success.

As early as 1805, Cincinnati may be said to have had a practical working observatory. In that year the first Surveyor-General of the United States, Colonel Jared Mansfield, received, after a delay of at least three years in their construction and transportation from London, astronomical instruments ordered by Albert Gallatin, Secretary of the Treasury, and paid for by President Jefferson out of his *own contingent fund*, "since no appropriation for them had been made by law." The instruments, which were said to have been excellent of their kind, were a 3-foot reflecting telescope, a 30-inch portable transit instrument, and an astronomical pendulum clock. Years afterward, they were placed in the philosophical department of the Military Academy at West Point. In the house of the Surveyor-General, at Cincinnati, they were used in making numerous and interesting astronomical observations. The orbit of the comet of 1807 was calculated, eclipses of different kinds were observed, the longitude of the observatory determined, and other observations of importance made from 1807 to 1813, all of them outside of the usual duties of the mere surveyor.

Our next date is at the end of the lapse of forty years. We are brought then to the marked era in astronomical interest already referred to, and to the labours of those who awakened that interest, especially of Ormsby M'Knight Mitchell.

Mitchell was a native of Kentucky. He graduated with honour at West Point, in 1829. Resigning from the army, and practising law in Cincinnati, he was made professor in the City College. He was an enthusiast in astronomy. He gave a series of lectures to the citizens in 1842, which created their Astronomical Society.

As the astronomer of the Society engaged for a ten-years' work, Prof. Mitchell sailed for Europe to purchase a telescope superior to any then in America. In the optical institute of Merz and Mähler, successors of the great Fraunhofer, at Munich, he found an object-glass of 12-inch aperture, which, after Lamont's test in his own tube, was pronounced superior to that of the Munich telescope. It was mounted, purchased for about 9,400 dols., and arrived in Cincinnati in 1845.

The Astronomical Society of that town meanwhile had secured from their fellow-citizen, N. Longworth, the gift of four acres of ground on one of the beautiful and commanding hills on the east of the city, and a fund of 11,000 dols. in shares of 25 dols. each.

Prof. Mitchell, on his return, devoted his whole energies to the erection of an observatory. Its corner-stone was laid November 10, 1843, on the site given by Longworth, on Mount Adams.

The observatory presented a front of eighty feet, ornamented with a Grecian Doric portico, and a depth of thirty, showing a basement and two storeys, with a central dome, covering an equatorial room twenty-five feet square, the roof being capable of entire removal when observations were to be made. The object-glass of the telescope had, as we have said, an aperture of twelve inches; its focal length was seventeen feet.

The equatorial room received the Munich instruments in March 1845. Prof. Mitchell began his labours with the enthusiasm of hope. Other necessary instruments were received: a 5-foot Troughton transit, lent by the Coast Survey, an astronomical clock, presented by Mr. M'Grew, of Cincinnati, and a chronometer lent by Messrs. Blunt, of New York. At the request of Prof. Bache, the telegraph company connected the observatory with their stations for the determination of longitude, Cincinnati being then a central point in such work. The Astronomer Royal, under whose instruction Mitchell had passed three months in 1842, urged, in an encouraging letter, that "the first application of his meridional instruments should be for the exact determination of his geographical latitude and longitude, and that his observing energies should be given to the large equatorial." With this advice, he directed his attention largely to the remeasurement of Struve's double stars south of the equator.

Airy and Lamont had invited him to make minute observations of the satellites of Saturn, since in the latitude of Cincinnati the planet is observed at a more favourable altitude than at Pulkova, twenty degrees farther north. To these, and chiefly "to the physical association of the double, triple, and multiple suns," he gave his close attention. He made interesting discoveries in the course of this review. "Stars which Struve had marked as oblong, were divided and measured; others marked double were found to be triple." He proposed a new method for observing, and new machinery for recording north polar distances or declinations. Prof. Peirce reported favourably on this method at the meeting of the American Association in 1851, and Prof. Bache, as Superintendent of the Coast Survey, indorsed their approval in his report for that year, presenting also a full account of work done by the new method, in observations made by the enthusiastic astronomer and his patient wife, who assisted him through all. It was claimed that the results rivalled the best work done at Pulkova. Mitchell was the first "to prepare a circuit interrupter with an eight-day clock, and to use it to graduate the running fillet of paper;" and to invent and use the revolving-disk chronograph, for recording the dates of star signals. Profs. Bache and Walker had declined to adopt the first of these improvements in astronomical appliances, through an apprehension of injury to the astronomical clock. Mitchell's work proved the apprehension to be groundless. His revolving disk is an invaluable invention. To the perfection of such methods and instruments, together with the routine work of observation, he gave all the energies not of necessity employed in outside labours devolving on him for his support. Unhappily these, at an early date, became almost absorbing. For the Astronomical Society, having secured their observatory and their director, had failed to secure a basis for his support. Mitchell relied on his professorship in the Cincinnati College: in two years the college was burnt down. He then relied on publications and lectures. He published the *Sidereal Messenger*, a work of three volumes. He delivered lectures of rare power and beauty in the chief cities of the Union. He stirred up an enthusiasm by these lectures, which quickened the movements resulting in the establishment of some of the first observatories of this day in the United States. But for his support, unhappily for the observatory, he was compelled to accept the position of chief engineer of the Mississippi and Ohio Railroad from 1848-52; and finally, in 1853, that of director of the magnificent Dudley Observatory at Albany, New York. He did not, however, remove from Cincinnati till 1859. In 1861 his country claimed him from astronomy for her own service. The observatory remained in charge of Mr. Henry Twitchell, of Cincinnati, who was Mitchell's chief assistant for twelve years.

On February 1, 1869, Mr. Cleveland Abbe, formerly employed at the Pulkova Observatory, and more recently at the United States Naval Observatory at Washington, accepted the place of director. His first annual report submitted a plan of wide and useful astronomical and magnetic and geodetic investigations. On these he entered vigorously. He first adopted for the United States the issuing of daily meteorological bulletins, now so widely known as adopted and used by the United States Signal Service Bureau.

During the years since Prof. Mitchell's leaving the institution, its future had appeared dark enough. In taking charge of the Dudley Observatory in 1859 he announced his expectation that "the Cincinnati Observatory was soon to be placed on a permanent foundation, and that each observatory would be occupied on a star catalogue down to the tenth magnitude." But it is not surprising that the interval of the war should retard the plans he had formed, and prevent, under all circumstances, their subsequent execution by his successors.

But in 1870 a movement was originated by Abbe, which, at the time this article was written, promises by its development to secure results worthy of the noble founder of the observatory, and of the West. A tripartite agreement has been secured between Mr. Longworth's heirs, the Astronomical Society, and the city, by which the sale of the old site was permitted, and the city pledged to maintain the observatory in connection with the university; original investigations, and not mere educational uses being guaranteed as its object. On Mount Lookout, one, of the highest points in Hamilton County, adjacent to a park not likely to be built up to the injury of astronomical observations, the corner-stone of the new observatory was laid, August 28, by the mayor of Cincinnati. The observatory is to be 71 ft. by 56 ft., with an elevation of 60 ft. It will be built of brick, trimmed with freestone. The pier of the Munich equatorial is to be of solid brick, with like capping; its height 36 ft., and its diameter 17 ft. The iron revolving turret dome adds half a storey. The meridional instruments occupy the wings.

The whole new enterprise owes its success thus far to the munificence of Mr. John Kilgour, of Cincinnati, who granted the site and a liberal grant of money. Cincinna holds that she has good ground of expectancy of success. What they need, what every observatory needs, is, first of all, an astronomer with provision for his maintenance, that he may be "free from other avocations and cares."

Fig. 1.—Ormsby McKnight Mitchell.

A true astronomer, then, first of all—before even the most imposing edifice or instruments. An astronomer with a true conception of his work, with the splendid objects before him, and the advantages of our day, may largely repay the benefactions of the liberal by the lasting benefits not of mere theory, but of the practical usefulness of discovery.

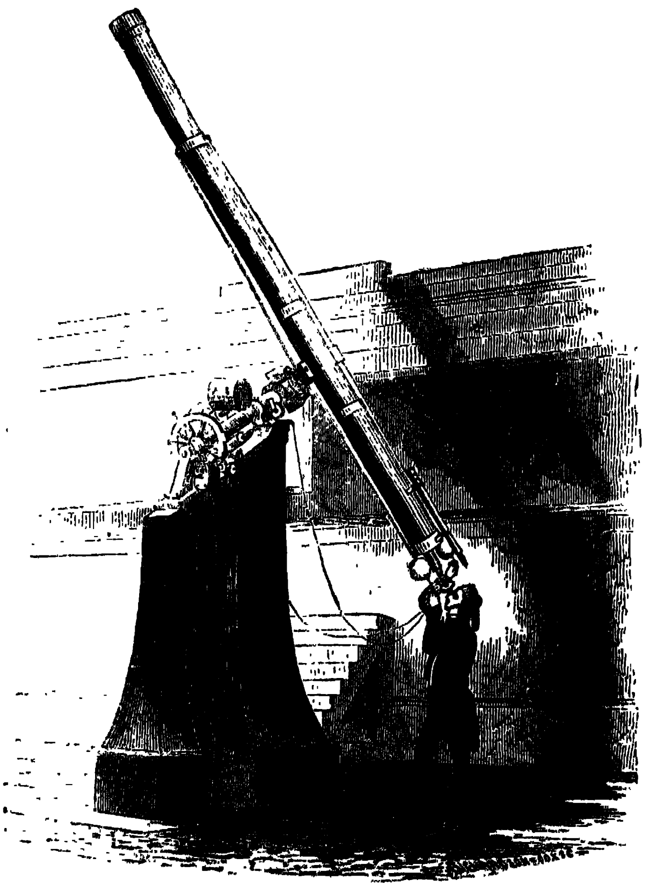

Fig. 2.—The Equatorial of Cincinnati Observatory.

The U.S. Naval Observatory.—The history of this Observatory is not a little remarkable.

Close on the isle on which stood what was known as the "Washington property," near the old Capitol, stood, in 1833, an unpretending wooden building but 16 ft. square, erected at the expense of a lieutenant of the navy, and equipped with a 5-foot Troughton transit instrument. This was the United States Naval Observatory in embryo.

The transit was one of the instruments made for the Coast Survey, under the supervision of Mr. Hassler, its first superintendent, during his long detention in England, by the breaking out of the war. Returning only in 1815, and the survey itself being soon arrested by Congress, his instruments and the "fixed observatory," the establishment of which he was the very first in the United States to propose, rested quietly *in statu quo ante bellum*. In 1832 the Coast Survey was revived; but as an observatory was peremptorily forbidden by the law, the transit was lent to Lieut. Wilkes for his observations.

Lieut. Wilkes's observations were, however, at first only for obtaining clock errors, needed for determining the true time for rating the naval chronometers then under his charge. This testing of all the chronometers and other naval instruments used by the United States ships (begun in 1830 by Lieut. Goldsborough) had been at once found a wise and useful economy for the navy. The Secretary, therefore, established this little receptacle for charts and instruments by placing an officer in charge' permitting him to build his own little observatory and do his own work. The "Depôt" was the christening then given to the establishment. This was all that Wilkes or any one of his successors dared call it even as late as 1842, when establishing the present astronomical institution.

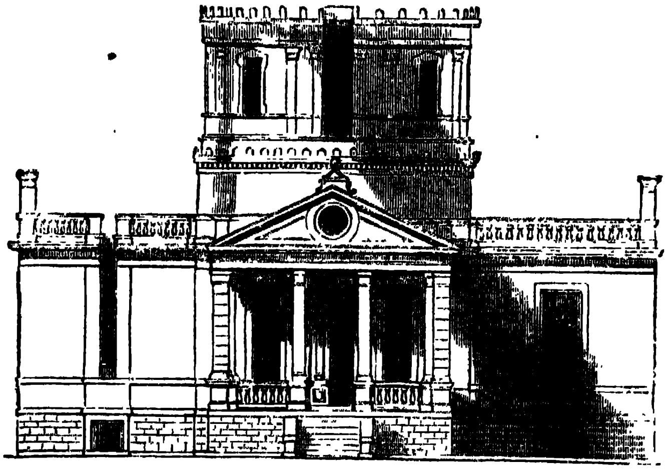

Fig. 3.—New Cincinnati Observatory—Front elevation.

But in 1838 a new call was made upon the Depôt, which turned the whole current of its future. The exploring expedition was about to sail for the South Seas. It would be of prime importance, in determining the longitude of places to be visited by the expedition, that corresponding astronomical observations should be made at home, to be compared on its return. Secretary Paulding gave the observations in the United States to Lieut. Gilliss, Wilkes's successor at the Depôt, and to Prof. Bond, of Cambridge. For the years 1838-42 Gilliss worked most accurately and unremittingly. With the help of an achromatic telescope, added by the Navy Department, and the transit before mentioned, he observed and recorded 10,000 transits; and his observations, afterwards tested by Prof. Peirce, were ranked by him among the highest then made. They are in the libraries of the astronomers of Europe. They procured, in fact, the founding of the present Naval Observatory.

For this, however, hard work in abundance was to be done. Gilliss urged the unsuitableness of his building erected alongside of Wilkes's wooden square room, and his want of space to erect a permanent circle. He won over the old Navy Commissioners and the indorsement of the Secretary to their recommendation for something better. He pressed the Naval Committees frequently and closely, but enlisted scarcely one, except Mallory, of the House. Almost to a man they kept away from the Depôt, although it was "so near," and no help seemed available. But a celestial visitant now appeared, as, singularly enough, another did in 1843 for the benefit of the Cambridge Observatory. It gained the day for Gilliss, and for an observatory at Washington. He had closely observed Encke's comet, and read a paper on it before the National Institute. When he made, shortly after this, his last intended visit to the Senate Committee, Preston of South Carolina asked, "Are you the one who gave us notice of the comet? I will do all I can to help you." In a week a bill passed the Senate; and, strangely enough, passed the House also, without discussion, on the last day of its session. It appropriated 25,000 dols.; but still "for a Depôt of Charts and Instruments."

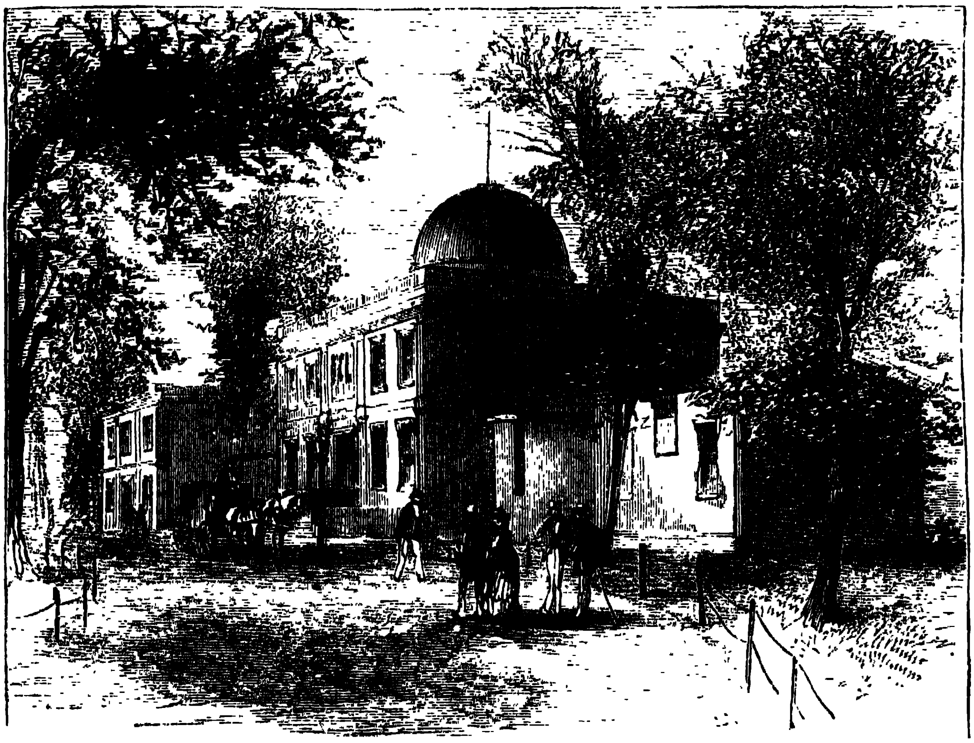

Fig. 4.- The United States Naval Observatory, Washington.

But the Secretary of the Navy was no longer officially bound by the name. The report of the committee, which secured the bill, was so expressly in favour of astronomical, meteorological, and magnetic objects, that Congress was justly understood to sanction them. Gilliss was sent abroad for instruments and plans for an observatory.

The site chosen by President Tyler for the building was fraught with historic interest. The square embraces a little more than nineteen acres in measurement. It is now tastefully laid out and ornamented. Nearly central within it stands the building represented in Fig. 4. It is on the second highest eminence within the city limits, commanding the view of the public buildings, of the neighbouring cities of Georgetown and Alexandria, and of Arlington.

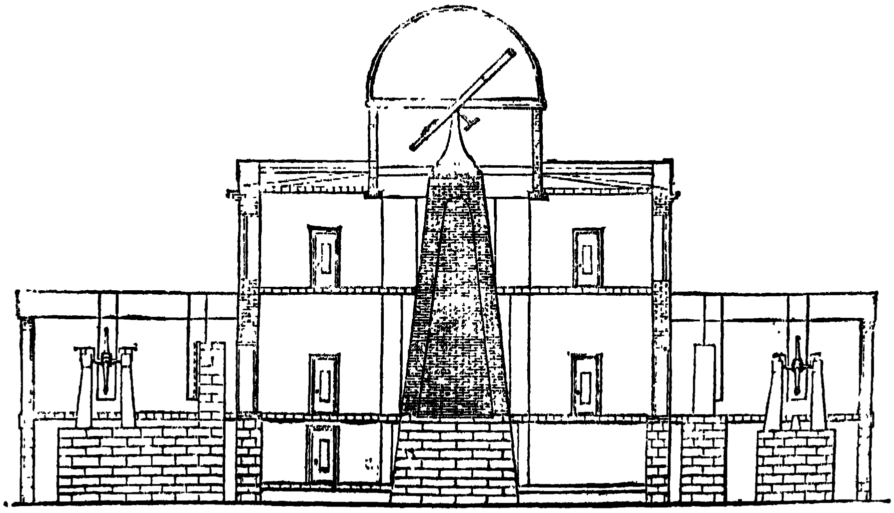

Fig. 5.—Section of Main building—United States Naval Observatory, 1844.

In 1844 Gilliss reported the completion and equipment of the central building. He had secured the excellent equatorial, the meridian circle, the transit, prime vertical, and mural circle on which so much valued work has been done. He had begun a library, to which nearly 200 volumes of the highest standard works were presented by the Greenwich, Paris, Berlin, and Vienna institutions.

(*To be continued.*)

A MONUMENT TO JEREMIAH HORROCKS

AT the last meeting of the Royal Astronomical Society, Prof. Adams said that he had been requested to call the attention of the Society to a petition which was about to be presented to Dean Stanley. It would speak for itself, and he would therefore read it to the meeting. It ran thus:—

To the Very Reverend the Dean of Westminster.

Reverend Sir,

It appears to us that the approaching transit of Venus offers a fitting occasion for the erection of a memorial to Jeremiah Horrocks, curate of Hoole, in Lancashire, to whom the science of astronomy is indebted for the earliest observation of Venus upon the sun's disc. He predicted, by his own calculations, the transit of the year 1639, which he and his friend Crabtree had the exclusive privilege of witnessing. The labours of Horrocks in connection with this memorable occurrence, as well as the originality of his views on other astronomical subjects, have, by the unanimous consent of scientific men, assigned to him a high place in the roll of illustrious astronomers who adorned Europe in the seventeenth century.

We therefore venture to request your permission to place in Westminster Abbey a tablet or some other memorial of Jeremiah Horrocks.

We have the honour to be,
Reverend Sir,
Your obedient Servants,

(Signed) by the Astronomer-Royal, the President of the Royal Astronomical Society, and a number of the most distinguished Fellows of the Society.

Prof. Adams remarked that he need not say anything further to recommend the signature of the memorial to the Fellows of the Society. It was perfectly impossible to estimate too highly the credit due to Horrocks, especially when his age and opportunities were taken into account. Not merely had he been successful in observing the transit of 1639, but he had first corrected the tables of Venus, from his own observations, and had thereby rendered his prediction of the transit possible. Had he merely followed the tables which had been published by Kepler, he could not have predicted the transit, and it would probably have slipped by unobserved. And this was by no means the only astronomical service rendered by Horrocks. His discovery of the law of libration of the moon's apogee constituted an important advance in the knowledge of the lunar motions. In fact, Sir Isaac Newton, when nearly half a century afterwards he attempted to explain those motions on mechanical principles, could not find any more convenient representation of the motion of the moon's apse than that which had been given by Horrocks. He had, therefore, great pleasure in bringing this petition to the notice of the Fellows of the Society.

FRENCH PREPARATIONS FOR THE TRANSIT OF VENUS

AT the meeting of the French Academy of June 29, M. Dumas gave in the Report of the Commission charged with making the necessary preparations for observing the approaching transit of Venus.

The stations chosen by the commission are Campbell and St. Paul Islands, Houméa, Pekin, Yokohama and Saïgon. Each expedition is under the charge of a chief, the conduct of the first having been intrusted to M. Bouquet de la Grye, the second to M. Mouchez, the third to M. André, the fourth to M. Fleuriel, the fifth to M. Janssen, and the sixth to M. Hérault. The observers altogether number twenty-five, accompanied by twenty-five assistants. M. Bouquet de la Grye has already left; M. Fleuriel is on the point of setting out for Pekin. M. Janssen loses no time in leaving for Yokohama, from which he will not return directly to Europe, having undertaken to go to Siam to observe the eclipse which will be visible there.

As Campbell and St. Paul Islands are perfectly barren, the expeditions destined for them have been specially cared for, being furnished with fuel and provisions for six months.

A sum of 300,000 francs was allotted by the State for the whole of the expeditions; but this sum having been found insufficient, the Minister of Marine has abundantly and generously provided for the wants which have been pointed out by the Commission. Indeed, the French Government has acted in the most handsome manner towards the various expeditions, which have been furnished with everything that is in any way necessary.

As to instruments, besides those which have been specially constructed for the enterprise, the depôt of Marine has placed at the disposal of the expeditions a large number of instruments, among which are thirty-one tested chronometers. Four of the expeditions have each received an equatoreal of 8 in. No expedition from any other country, the Report states, will be possessed of instruments so powerful. Equatoreals of 6 in. have been furnished to the six expeditions, and telescopes of the same power as those adopted by the various expeditions of other countries.

Various photographic apparatus and methods of observation have been proposed. The Commission has decided in favour of the system of M. Fizeau, who has himself superintended the construction of instruments and initiated the operators in all the practical details which they ought to follow.

ON VAPORISING METALS BY ELECTRICITY

THE following simple results obtained by frictional electricity may be of interest, perhaps too of use in the investigation of certain minerals and the action of intense heat upon them.

The description of a characteristic experiment is all that will be necessary to explain the process and to show how similar results may be obtained from other substances. A very fine thread of sheet platinum, of about an inch in length, is placed between two microscopic slides of glass, and two pieces of thin sheet copper with rounded ends are placed in contact with the extremities of the platinum, the copper being any convenient length and breadth, so as to extend beyond the glass slides, but not to be as broad; a charge of electricity from about eight square feet of Leyden jar is passed through the metals; the effect of the heat from the charge is to vaporise the platinum, which is instantly condensed in a transparent layer upon the cold glass. The layer can be investigated by a microscope, and employed in various ways to determine the character of the metal and its effect upon reflected or transmitted light.

Copper, tinfoil, tinfoil amalgamated with mercury, gold and silver, can be used in a similar manner, but they produce layers very dissimilar in appearance. To act upon finely-ground substances, such as vermilion, sulphate of antimony, sulphur, &c., a line of the powder must be made and the charge be passed through in the same way as through the platinum.

Part of the vapour escapes from between the slides, but this can easily be condensed upon each of two pieces of glass placed in such a way as to intercept the vapour as it passes from between the two slides; it is then condensed in a long but narrow line. The manner in which the glass is affected by the heat, and the concussion produced by the expansion of the vapour, are worthy of notice.

Considerable difficulty will be found in vaporising copper, doubtless from its being such an excellent conductor. Some of the powdered substances appear to require a small spark to be passed through them before they allow a larger charge to pass, as if the particles needed polarisation.

G. H. HOPKINS

THE HERPETOLOGY OF NEW GUINEA[*]

DR. ADOLF BERNHARD MEYER, who, as most of the readers of NATURE will be aware, has lately returned from a very successful expedition to New Guinea, has published in the "Monatsberichte" of the Berlin Academy a short account of his herpetological discoveries, which present several points of interest. Previous investigators of the natural history of this wonderful land have paid more attention to its birds than to its reptiles and amphibians—a circumstance perhaps scarcely to be wondered at in the land of paradise-birds and so many other anomalous forms. Dr. Meyer, however, while he has by no means neglected the class of birds, as shown by his recent communications upon that branch of zoology to the Academy of Vienna, has likewise paid much attention to the representatives of the inferior orders of reptiles and batrachians which he met with in New Guinea and the adjacent islands. Although this branch of the Papuan fauna is well known to be comparatively poor, Dr. Meyer's labours have been by no means without result. Of sixty-three different forms belonging to these orders of which he collected specimens, thirty-four have turned out to be new to science; and of the remaining twenty-nine, the greater part were previously not known to occur in this locality.

Of tortoises, besides the marine *Chelone imbricata*, only one was obtained in New Guinea, which, however, was of a new species belonging to an Australian form. Of lizards, upwards of thirty species were collected, amongst which Australian types are again predominant. Amongst the sixteen serpents met with in New Guinea, Jobi, and Mysore, were several of special interest. The Australian carpet snake, *Morelia*, is represented by an allied form, proposed to be called *Chondropython*, besides which two other new genera are described, one belonging to the boas, and the other to the colubrine snakes.

Of batrachians, Dr. Meyer collected specimens of nine species in New Guinea and its islands, five of which he considers to be hitherto undescribed.

It will be thus evident that Dr. Meyer has made a by no means inconsiderable addition to our knowledge of this branch of the Papuan fauna. At the same time it cannot be supposed that we are, as yet, by any means perfectly acquainted with the herpetology of New Guinea when so little is known of the vast interior of this strange country.

COGGIA'S COMET

AN observation taken here on July 4, shows so close an agreement with the position calculated from my parabolic elements in NATURE (vol. x. p. 149), that it appears unlikely the comet can have so short a period as 137 years, and consequently that, notwithstanding similarity of orbits, it probably is not identical with the body observed by the French Jesuits in China in July 1737. Between April 17, the date of discovery, and July 4 it had traversed an arc of just 90° of true anomaly, and if any decided ellipticity existed, so wide an arc must have shown it, the stellar appearance of the nucleus having admitted of very exact observation throughout. On July 4, twenty-one days after the last position I employed in determining the orbit, the computed right ascension differs only 20″, and the declination 14″ from the observation. In all probability, therefore, the comet has not visited these parts of space within many centuries.

Measures of the diameter of the nucleus on July 4 gave nearly 14 seconds of arc, the distance of the comet at the time, by my elements, being 0·6016, which indicates a real diameter of about 3,750 miles; it has, perhaps, slightly contracted within the last fortnight.

This morning Mr. W. Plummer, at this observatory, found the comet equal in brightness to α Persei, a second magnitude star in Argelander's Atlas.

I may here mention that for calculation of actual dimensions or distances I take the sun's parallax, after M. Leverrier = 8″·86, which, combined with Capt. A. F. Clarke's value of the earth's equatorial semi-diameter, gives for the mean distance of the earth from the sun, 92,268,000 miles, a figure that I believe to be as probable as any now to be attained. The moon's mean distance from the earth, adopting Prof. J. C. Adams's parallax, is thus found to be 238,800 miles, or 60·273 equatorial radii of our globe.

J. R. HIND

Mr. Bishop's Observatory,
Twickenham, July 7

DE CANDOLLE'S PROPOSED "PHYSIOLOGICAL GROUPS" OF PLANTS

IN the *Archives des Sciences Physiques et Naturelles*, No. 197, M. de Candolle proposes a new classification of the vegetable kingdom, based on the physiological relations of plants to heat and moisture, which he believes affords a means of tracing the connections of recent and fossil floras in a way which neither botanical nor geographical grouping do. He makes six divisions altogether.

1. The first of his "physiological groups" consists of those which need much heat and much moisture, and to them he gives the name Hydromegatherm, or, for short, Megatherm. These at present live in the tropics, and sometimes as far as 30° N. and S., in warm and damp valleys, where the temperature is never below 20° C., and the rains never fail. The predecessors of the existing Megatherms were widely spread, but at the commencement of the Tertiary period they became confined pretty much to the equatorial zone. Their botanical characters vary considerably, and they are represented in almost all cases by different species in Asia, Africa, and America. The most characteristic families are Menispermaceæ, Byttneriaceæ, Ternstrœmiaceæ, Guttiferæ, Sapindaceæ, Dipterocarpeæ, Sapotaceæ, Apocinaceæ, Aristolochiaceæ, Begoniaceæ, Piperaceæ, &c.

2. His second group requires heat with dryness. Xerophiles he proposes to call them. Their present distribution is in dry and warm regions of from 20° or 25° to 30° or 35° on each side of the equator (their particular districts are carefully noted). The group includes a large proportion of Compositæ, Labiatæ, Boraginaceæ, Liliaceæ, Palmæ, Myrtaceæ, Asclepiadaceæ, Euphorbiaceæ; but the most characteristic are Cactaceæ, Ficoideæ, Cycadaceæ, Proteaceæ, and Zygophylleæ. There are few large trees, few annuals, and the aspect of vegetation is but meagre. The palæontology of the regions where Xerophiles now exist is too little known for us to be able to trace the former migrations of plants forming this group.

3. The third group includes those plants which require a moderate heat, 15° to 20° C., and moderate moisture, and are named Mesotherms. They are now found around the Mediterranean, in the slightly elevated regions of India, of China, Japan, California, Central United States,

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[*] "Uebersicht der von mir auf Neu Guinea, und den Inseln Jobi, Mysore, und Mafoer im Jahre 1873, gesammelten Amphibien." Von Dr. Adolf Bernhard Meyer. (Berlin: Monatsb. Akad., 1874.)

the Azores, and Madeira, and in the plains and low valleys of Chili, Monte Video, Tasmania, and New Zealand. Their characteristic families are the Laurineæ, Juglandeæ, Ebenaceæ, Myricaceæ, Magnoliaceæ, Aceraceæ, Hippocastaneæ, Campanulaceæ, Cistiaceæ, Philadelphiniæ, Hypericaceæ, mixed however with a large number of Leguminosa, Compositæ, Cupuliferæ, Labiatæ, &c.

4. The fourth group is of plants of temperate climates having annual means of 14° to 0° C., and these are named Microtherms. In Europe they occupy plains from the Cevennes and Alps to the North Cape, in Asia from the Caucasus or Himalaya, to 65°, in America from 38° or 40°, to 60° or 65°. They are also met with in Kerguelen, Campbell, and the Malonine Islands, and the mountains of New Zealand. No characteristic families are enumerated, as it is the absence of forms that are usually Mesotherms and above all of Megatherms or Xerophiles, which distinguishes this group.

5. The fifth group is of plants living in arctic or antarctic regions, or high on mountains in temperate regions. They need but little heat, and hence are called Hekistotherms. One of their important characteristics is that they can endure the absence of light during the time they are covered with snow. Though no family belongs entirely to this group, Mosses, Lichens, Grasses, Crucifers, Saxifrages, Roses, and Composites bear a large proportion to the whole. Some species of Betula, Salix, Empetrum, Vaccinium, and certain Conifers also are Hekistotherm.

6. The sixth group includes exceptional plants; those requiring a mean annual temperature of more than 30° C., for which the name Megistotherm is proposed.

After the description of his proposed groups, M. de Candolle at once faces an objection he sees is sure to be raised, and that is the difficulty of classing a species under any one particular group. His reply is that it is always possible to do so if due attention is paid to the conditions under which it lives, both by studying the climatal conditions of its native country, and by experimental culture. Fossil plants, he admits, can only be classed by analogy; but he very justly adds that in determining their botanic affinities in like manner there is generally nothing but analogy to rely on, flowers and fruits being wanting. In answer to the possible objection that there are transitions from one group to another, and that the limits are arbitrary, he is content to reply that though a classification based on botanical characters may be more precise, the limits of geographical groups and of geological periods are equally wanting in exactness.

The fact that his physiological groups in no way coincide with established botanical or geographical groups is worth notice. All families that are at all numerous in species are represented in more than one of these physiological groups, and sometimes in them all. To give only one instance, the Primulaceæ live in almost all cold and temperate regions, and yet the Myrsineaceæ, which are their woody representatives, are found in the tropics. Even in genera which have not many varieties of form, the same is the case. The Cassias, for example, are mostly Megatherms or Mesotherms, yet *Cassia marylandica* flourishes at Geneva, where the winter minimum is sometimes 25° C. Some willows flourish far north, yet *Salix humboltiana* is met with in the district of the Amazon, and *Salix safsaf* grows in Egypt.

Is there any connection between the physiological properties of plants and the form of their organs of vegetation? M. de Candolle thinks not. For example: there is no recognisable difference between the forms and tissues of ferns which we have to preserve in hot-houses and those which will grow in the open air. There are many facts such as these which seem to show that there is no direct relation of cause and effect between the form and those physiological qualities of plants which have reference to climatal conditions. There is rather a dependence on some common cause which has influenced both sets of phenomena, which M. de Candolle refers to heredity. A species has a particular form because its ancestors had a form more or less the same. It has certain physiological qualities with reference to climate because the exterior conditions which have been imposed on it through innumerable ages have prevented other qualities from being developed and have secured the heredity of those which have enabled it to live. This, he considers, is the key to the explanation why a flora of any particular climate does not present in the totality of its species any distinctive peculiarities. Arctico-Alpine plants are of different families, and it is impossible to point to any development of an organ which cannot also be met with in tropical plants. The ascendants of Arctico-Alpine plants have lived together, and only certain of them have lived together through changes of temperature. Physiological qualities may be changed in length of time when exterior conditions have not changed in such a way as to cause a species to perish. M. de Candolle lays great stress on the fact we learn from the experience of horticulturists, that it is much more rare to obtain any change in the power of a plant to endure modifications of climate than it is to obtain change of form. A period of greater length than the historic period of Europe seems to be needed for a modification of physiological conditions; witness the fact that for some 3,000 years the date has been grown in Greece and Italy without any success in getting the fruit to ripen. The fact that physiological conditions are so much more permanent than form is to M. de Candolle a strong argument in favour of his physiological groups. The impossibility of making geographical groups perfectly true, together with the fact that the climates of each region have changed from one period to another, is also claimed as additional argument in favour.

For the purpose of showing that these groups make the facts of geographical botany, both of geological and present times, more precise and more easy of discussion as regards general laws, their distribution in Europe since the commencement of the Tertiary period is taken as an illustration. The works of Gœppert, Heer, Unger, Garovaglio, Ch. T. Gaudin, Saporta, &c., have supplied M. de Candolle with his data, and on comparing the fossil floras with recent forms he has had no difficulty in classifying them according to his groups. He, of course, goes on the hypothesis that like forms have sprung from like antecedents possessing like hereditary physiological properties. As an illustration that any uncertainty there may be is within limits, he points out that though a fossil Ficus might be taken for a Megatherm or Mesotherm, it could never be mistaken for a Microtherm or Hekistotherm, since we do not now know any Ficus capable of resisting such cold. A fossil Betula may have been Microtherm or Hekistotherm, but not Megatherm.

Acting on these hypotheses he has reduced his results to tabular form, prefacing the remark that his great difficulty has been to class the different fossil floras according to geological periods that could be relied on; stratification and not palæontology being the only safe basis of relative age grouping.

Different climates prevailed in different parts of Europe during the Tertiary period as well as now, and he urges it must be recollected that when two fossil floras (faunas equally so) which are much alike are met with in widely separated latitudes, they cannot have been contemporaneous. In the same latitude, too, difference of elevation will have had a similar effect to difference of latitude. Floras of quite different facies may therefore have been contemporaneous.

In transcribing the following table and explanations we have given only the name of the author who has described the floras. M. de Candolle gives exact references to the works where the descriptions may be found.

Distribution of Physiological Groups in Europe since the Commencement of the Tertiary Period according to our present knowledge of Existing and Fossil Floras

Lat. N.	TERTIARY						QUATERNARY		Lat. N.
	Eocene			Miocene		Pliocene	Glacial	Recent	
	Lower	Middle	Upper	Lower	Upper				
90									90
								E	
85									85
								E	
80									80
				? C13+D4			? E4	E	
75									75
								E	
70									70
				C14+D5				D	
65									65
								D	
60									60
							E1	D	
55									55
	A6			C9			D3 E2	D1 D	
50									50
	A5+C12	? A4 A3+C11		A1+C8	C7 C6	C2	D2 E3	D	
45									45
			A2+C10	C5	C4		C1	C+B	
40									40
								C+B	
35									35
						? C3		B	
30									30
								B	
25									25
								B A	
20									20
								A	
15									15
								A	
10									10
								A	
5									5
								A	
0									0

EXPLANATION OF THE TABLE

A.—*Megatherms.*

A. Existing Megatherms.

A¹. Beds of Monod, Paudeze (Heer). Mesotherms are mixed with Megatherms.

A². "Gypses d'Aix." Megatherms with Mesotherms C¹⁰.

A³. Chiavone and Salcedo (Massalongo). Mesotherms are mixed with Megatherms but the former are in large proportion.

A⁴. "Sables supérieurs du Soissonnais" (Watelet), containing a large proportion of Megatherms. The stratigraphical position of these beds, it should be noted, is inferred from palæontological evidence rather than from superposition.

A⁵. Bolca (Massalongo), although mixed with Mesotherms, Megatherms preponderate.

A⁶. Sheppy (Bowerbank, Ad. Brongniart, Lyell).

B.—*Existing Xerophiles.*

The countries where fossil floras of this character are to be expected have not been worked geologically, and no bed containing Xerophiles is known.

C.—*Mesotherms.*

C. Existing and recent Mesotherms.

C¹. Many floras in the south-east of France worked out by Saporta.

C². Meximieux (Saporta).

C³. S. Jorge, Madeira (Heer).

C⁴ and C⁵. South-east of France (Saporta). Some Megatherms occur in his lists, but they do not form a fourth part of each flora.

C⁶. Piedmont (Sismonda).

C⁷. Œningen (Heer).

C⁸. Monod, Paudeze (see A¹).

C⁹. Dantzig (Heer). The lower bed contains Sequoid, Smilax, Myrica, Ficus, Lauraceæ, Juglandaceæ, &c.

C¹⁰. "Gypses d'Aix" (see A²).

C¹¹. Chiavone and Salcedo (see A³).

C¹². Bolca (see A⁵).

C¹³. Spitzbergen (Heer), mixed with Microtherms D⁴.

C¹⁴. Iceland (Heer), mixed with Microtherms D⁵.

D.—*Microtherms.*

D. Existing and recent Microtherms.

D¹. Cannstadt alluvial deposits.

D². Laminated lignites of Durnten (Heer).

D³. Cromer forest bed (Lyell, Heer).

D⁴. Spitzbergen (Heer), mixed with C¹³.

D⁵. Iceland (Heer), mixed with C¹⁴.

E.—*Hekistotherms.*

E. Existing Hekistotherms.

E¹. Southern Sweden, Denmark (Nathorst).

E². Mecklenburg and Cromer below the forest bed (Nathorst).

E³. Glacial clay of Schwerzenbach—between Zurich and Constance—(Nathorst).

E⁴. Superficial diluvium of Spitzbergen (Heer).

Signs.

+ When two groups are united by the plus sign it means that at least one-fourth of the flora is made up of the second group indicated.

? The note of interrogation is used to imply that the geological age of the bed is doubtful.

Setting out with the belief that at a most remote period there was all over the globe a high and nearly uniform temperature, followed by a gradual cooling and the development of diversities in climates M. de Candolle proceeds to show that the earliest plants must have been Megistotherm. With the exception of the carboniferous, we are too imperfectly acquainted with the floras of Primary and Secondary periods to trace their distribution. At the commencement of the Tertiary period Megatherms occupied all the then land surfaces up to 58°. The other groups became gradually separated, and migrated as increase of cold drove them from their former areas. The means by which this was effected is a matter of hypothesis, but it is not hypothesis to say that the various groups never sprung from a single group. It cannot be proved that there formerly existed a single form of vegetation, while M. de Candolle urges that the surface of the globe certainly had formerly one uniform climate. The distribution of physiological groups indicates two sorts of floras, one migratory, the other fixed. Intertropical floras have had but few vicissitudes, arctic and antarctic have experienced many.

We submit this *résumé* of M. de Candolle's proposal and illustration without at present offering any remarks.

NOTES

THE usual programme of the forthcoming (the 44th) meeting of the British Association at Belfast has been issued. The First General Meeting will be held on Wednesday, Aug. 19, at 8 A.M. precisely, when Prof. Williamson, F.R.S., will resign the chair, and Prof. Tyndall, F.R.S., President-elect, will assume the presidency, and deliver an address. On Thursday evening, Aug. 20, at 8 P.M., there will be a Soirée; on Friday evening, Aug. 21, at 8 P.M., a Discourse by Prof. Huxley, F.R.S.; on Monday evening, Aug. 24, at 8.30 P.M., a Discourse by Sir John Lubbock, Bart., M.P., F.R.S.; on Tuesday evening, Aug. 25, at 8 P.M., a Soirée; on Wednesday, Aug. 26, the concluding General Meeting will be held at 2.30 P.M. The following are the officials of the various sections:—A, Mathematical and Physical Science.—President: Rev. Prof. J. H. Jellett, M.R.I.A. Vice-Presidents: Prof. Everett, F.R.S.E.; Prof. Purser, M.R.I.A. Secretaries: Prof. W. K. Clifford, F.R.S.; J. W. L. Glaisher, F.R.A.S.; Prof. Herschel, F.R.A.S.; Randal Nixon; G. F. Rodwell, F.R.A.S. B, Chemical Science.—President: Prof. A. Crum Brown, F.R.S.E. Vice-Presidents: Prof. Maxwell Simpson, F.R.S.; Dr. Debus, F.R.S. Secretaries: Dr. J. F. Hodges, F.C.S.; W. Chandler Roberts, F.C.S.; Prof. Thorpe, F.R.S.E. C, Geology.—President: Prof. Hull, F.R.S. Vice-Presidents: Prof. Harkness, F.R.S.; Prof. Geikie, F.R.S. Secretaries: Louis C. Miall; R. G. Symes. D, Biology.—President: Prof. Redfern, M.D. Vice-Presidents: Dr. Hooker, C.B., Pres. R.S.; Sir W. R. Wilde; J. Gwyn Jeffreys, F.R.S. Department of Anatomy and Physiology.—Prof. Redfern (president) will preside. Secretaries: Dr. J. J. Charles; Dr. P. H. Pye-Smith. Department of Zoology and Botany.—Dr. Hooker, C.B., Pres. R.S. (vice-president), will preside. Secretaries: Prof. W. T. Thiselton-Dyer, Prof. R. O. Cunningham, F.L.S. Department of Anthropology.—Sir W. R. Wilde (vice-president) will preside. Secretary: F. W. Rudler, F.G.S. E, Geography,—President: Major Wilson, F.R.S., Director of the Topographical Department of the Army. Vice-presidents: Sir Bartle Frere, G.C.S.I., K.C.B., F.R.G.S.; Admiral Ommanney, C.B., F.R.S.; Major-General Strachey, F.R.S.; Secretaries: E. G. Ravenstein, F.R.G.S.; E. C. Rye; J. H. Thomas, F.R.G.S. F, Economic Science and Statistics.—President:——. Vice-presidents: W. Donnelly, C.B.; Prof. T. E. Cliffe Leslie. Secretaries: F. P. Fellowes, F.S.A.; E. Macrory. G, Mechanical Science.—President: Prof. James Thomson, F.R.S.E. Vice-presidents: Sir John Hawkshaw, F.R.S.; Sir Charles Lanyon. Secretaries: James Barton; E. H. Carbutt; J. N. Shoolbred, F.G.S.

THE announcements for holding the twenty-third meeting of the American Association for the Advancement of Science at Hartford, Connecticut, on Aug. 12, have been issued by the secretary, in which we are informed that the head-quarters will be at the State House. Dr. John L. Leconte, of Philadelphia, is president of the coming meeting; Prof. C. S. Lyman, vice-president; F. W. Putnam, of Salem, permanent secretary; Dr. A. C. Hamlin, general secretary; and William S. Vaux, treasurer. The Hon. H. C. Robinson is chairman of the local committee.

A MARBLE *replica* of Woolner's remarkably fine bust of the late Prof. Sedgwick has just been placed in the hall of the Geological Museum in Jermyn Street, the gift of a lady who wishes to be anonymous. The School of British Geology is now well represented in this museum by the busts of the following geologists:—Hutton, Playfair, Sir James Hall, William Smith, Greenough, Buckland, De la Beche, Forbes, Murchison, and Sedgwick.

IT will be heard with regret that Dr. J. Hughes Bennett has been obliged, on account of his health, to intimate his resignation of the Chair of Physiology in the University of Edinburgh. It is understood that Dr. McKendrick, Dr. Bell Pettigrew, and Prof. Rutherford will offer themselves for the vacant chair.

PROF. SCHROEDER of Erlangen (*Deutsche Archiv für klinische Medicin*) confirms, by a remarkable case occurring in his own practice, the previous observations of Winkel and C. Braun, of the occasional occurrence of small cysts in the mucous membrane of the vagina of pregnant females containing some kind of air. These cysts he proposes to call air-cysts. When they are opened the air escapes with a report or crack. These observations, if verified by subsequent inquirers, will form a remarkable addition to the pathology of gaseous secretion or production.

THE Observatory at Kiel, of which Dr. C. A. F. Peters is director, is to be removed to Altona, in order to be in closer connection with the University.

THE death is announced of Mr. Henry Grinnell, of New York, whom the English public will remember in connection with the Grinnell Arctic Expedition.

AT the distribution last week of prizes at King's College, Mr. W. E. Forster, M.P., gave an address in which, among other subjects, he contrasted the expense of educating a boy from the age of nine to twenty-two at the older schools and universities with the cost of education during the same period at King's College; in the former case it is between 1,600*l.* and 1,800*l.*, in the latter only 400*l.* Mr. Forster also referred to the superior advantages, in some respects, of German over English schools; he might at the same time have pointed out that a German boy can obtain the best education which his country can give at a cost of something like 5*l.* a year, which for the thirteen years between nine and twenty-two amounts to the ridiculously small sum of 65*l.*

AT St. John's College, Cambridge, in April 1875, there will be offered for competition an Exhibition of 50*l.* per annum for proficiency in Natural Science, the Exhibition to be tenable for three years in case the Exhibitioner have passed within two years the Previous Examination as required for candidates for honours: otherwise the Exhibition to cease at the end of two years. The candidates for the Exhibition will have a special examination (commencing on Saturday, April 3, at 1 P.M.) in (1) Chemistry, including practical work in the laboratory; (2) Physics, viz. Electricity, Heat, Light; (3) Physiology. They will also have the opportunity of being examined in one or more of the following subjects (4) Geology; (5) Anatomy; (6) Botany, provided that they give notice of the subjects in which they wish to be examined four weeks prior to the examination. No candidate will be examined in more than three of these six subjects, whereof one at least must be chosen from the former group. It is the wish of the master and seniors that excellence in some single department should be specially regarded by the candidates. They may also, if they think fit, offer themselves for examination in any of the Classical or Mathematical subjects. Candidates must send their names to one of the tutors fourteen days before the commencement of the examination. The Exhibition is not limited in respect to the age of candidates, and is not vacated by election to Foundation Scholarships.

THERE will be an examination at Queen's College, Cambridge, on Thursday, Oct. 8, 1874, for an Exhibition for proficiency in Natural Science, open to all persons under twenty years of age who shall not have commenced residence in the University. The Exhibition will be of the value of 40*l.* per annum. Candidates will be required to pass an examination in elementary classics and mathematics. No Exhibition will be given unless the examiners report that a candidate merits such a distinction. Each candidate must forward to the President of the College before the day of examination a certificate of birth or baptism, and a certificate of good conduct from a graduate of Cambridge, Oxford, or Dublin. The successful candidates will be required to enter their names on the boards of the College and to commence residence at once. Further particulars will be furnished by the Rev. Dr. Campion, or the Rev. G. Pirie, Tutors of the College.

The first number of a new journal, which promises to be an important organ on an important subject, appeared on Saturday last. The *Sanitary Record*, a weekly journal of public health, proposes for its object, to collect and digest information relating to the health of the people, now much scattered, and therefore in a condition much less available for reference and study than it might be. It is also to contain original papers in which sanitary points are discussed in their scientific, social, and legislative aspects; together with reviews of the British and foreign literature of the subject. The staff of contributors includes names of many who hold the highest scientific position, and who are well known as authorities on hygienic matters. Miss Octavia Hill and several other ladies are also included; a paper by Miss Beale, Principal of the Cheltenham College for Ladies, appearing in the first number, while others are promised shortly by Miss Stanley, Miss Hill, and Mrs. E. Maurice. We are convinced that this new journal will fill a gap which has existed for some time; and, from the introductory number before us, we think that no one will have reason to complain of the manner in which it has been organised and started.

Prof. O. C. Marsh, of Yale College, has directed attention, at a recent meeting of the Connecticut Academy of Arts and Sciences, to the peculiarly diminished capacity of the brain-case in some of the Tertiary mammalia of North America. This is most marked in the Eocene genus Dinoceras, an animal which must have been nearly as bulky as a full-sized elephant, and yet its brain could not have been more than one-eighth the average bulk of that in the Indian rhinoceros. In the Miocene Brontotherium the brain-case was considerably large proportionately; and in the Pliocene Mastodon bigger still. These facts have an important bearing on the evolution of mammals, and open an interesting field for further investigation.

An important addition to ornithological literature has just appeared in the form of Mr. Sharpe's "Catalogue of the Birds in the British Museum," of which the first volume, comprising the Accipitres, or Raptorial birds, is before us.

We believe that at a recent meeting of the Council of the Zoological Society it was determined that a new building, on a large and much improved scale, should be commenced next spring and completed during the summer, to contain the lions, tigers, and other large feline animals.

The Senate of the University of London, at a meeting on July 1, adopted the following amendment by 17 votes to 10 on a proposal to obtain a new charter enabling the University to confer degrees on women:—"That the Senate is desirous to extend the scope of the educational advantages now offered to women, but it is not prepared to apply for a new charter to admit women to its degrees."

The well-known German ethnologist, Dr. A. Bastian, is about to publish a work with maps and illustrations, giving the results of the German expedition to the coast of Loango.

M. Leverrier has asked for an authorisation to attend or to send a representative to the Maritime Congress, the programme of which we gave in a recent number.

The comet is beginning to attract the notice of the general public. Telescopes are let on hire in several parts of Paris to get a view of it.

The balloon of the Observatory of Paris is undergoing repairs under the superintendence of M. W. de Fonvielle. It will be used by him in making ascents in order to verify the law of barometric pressure calculated by Laplace. Trigonometrical measures will be taken of the balloon by the astronomer of the Paris Observatory. The balloon is a silk one worth 1,600*l.*, which was built during the war and was used for making captive ascents by the *armée de la Loire*. It is to be called the *Neptune*.

Scientific ascents are becoming numerous in Paris. Last Friday a balloon was sent up from La Villette gasworks to try an apparatus invented by M. Jules Godard to ascertain whether the balloon is descending or ascending. The motor of the apparatus is a large horizontal disc, which is pushed by air pressure and puts in motion an electrical signal. The contrivance is rather heavy and bulky, and the rate of motion gives no idea of the numerical value of the movement.

We take the following from the *Academy*:—"Some of the American papers state that Prof. Huxley is likely to be the successor of Prof. Agassiz, at Harvard. We hope there is no truth in this. Are the English Universities so rich in really eminent professors, and so poor in money, that they can or must allow Prof. Huxley to go to America in order to find leisure for work? It would require nothing but the will for either Oxford or Cambridge to offer Huxley two or three thousand a year, without anybody suffering for it. There are hundreds of non-resident Fellows, doing no good to the University, doing harm to themselves in resting on their oars, when they ought to be pulling with all their might. Why not give five or ten such Fellowships to men like Huxley, and make the Universities again what they were in the middle ages, the very centres of intellectual force and light in the country? The Universities are so rich that they could beggar the whole world. Will they allow themselves to be beggared by Harvard?"

The first number of the *Linguist and Educational Review*, a monthly journal devoted to language, antiquities, science, and education, has appeared; its object is the popular treatment of the various branches of ethnology, folk-lore, and kindred subjects. This first number contains an interesting article on practical education, in which the wider use of the natural sciences in schools is advocated and the disproportionate amount of time spent on the study of the classics deprecated. It also contains several other interesting articles in ethnology, &c. We gladly note that the editor intends to give a portion of space monthly to the proceedings and papers of local scientific societies.

At the General Monthly Meeting of the Royal Institution, on Monday, the Secretary reported that Lady Fellows, the widow of Sir Charles Fellows, who was long a member and frequently a manager of the Royal Institution, had bequeathed to the Institution her drawings of Sir Charles's celebrated collection of watches, bequeathed to the British Museum.

Arrangements have been concluded between the proprietors of the *Daily Telegraph* and Mr. Bennett, proprietor of the *New York Herald*, under which an expedition will at once be despatched to Africa, with the objects of investigating and reporting upon the haunts of the slave-traders, of pursuing the discoveries of Dr. Livingstone, and of completing if possible the remaining problems of Central African geography. This expedition has been undertaken by and will be under the sole command of Mr. Henry M. Stanley.

At the fortieth Annual Meeting of the Statistical Society, held on June 30, the report showed an increase of seventy-six Fellows in the year ending December 31, 1873. By consequence, the financial state of the Society is satisfactory, the surplus of assets over liabilities being 2,508*l.* Dr. Guy was re-elected president.

It was reported last week that the cable steamer *Faraday* (see Nature, vol. x. p. 64) had struck on an iceberg off Halifax and became a total wreck. Happily this rumour has been proved to be without foundation.

On Saturday last, July 4, a meeting of the Council of the Royal School of Mines was held at the Jermyn Street Museum, at which the reports of the examinations of the students connected with that institution were received and considered, and the prizes awarded. The following gentlemen received the diploma of Associate of the Royal School of Mines:—Mining, Metallurgical, and Geological Divisions, S. A. Hill and W. Saise; Mining and Metallurgical Divisions, R. Cowper, A. R. Guerard, C. Lloyd Morgan; Metallurgical Division, W. Pearce; Geological Division, A. R. Willis and W. Frecheville. The two Royal Scholarships of 15*l*. each for first year's students were awarded to Henry Louis and E. Fisher Pittman; H.R.H. the Duke of Cornwall's Scholarship was awarded to A. R. Willis, and the Royal Scholarship of 25*l*. to W. S. Lowe; the Edward Forbes Medal and prize of books were awarded to A. R. Willis; the De la Beche medal and prize of books to C. Lloyd Morgan; the Murchison Medal and prize of books to A. R. Willis.

The Quarterly Weather Report of the Meteorological Office has been issued, containing the observations of the seven observatories from April to June 1873.

The additions to the Zoological Society's Gardens during the last week include a Himalayan Bear (*Ursus tibetanus*), presented by Mr. George Lockie; two Red Kangaroos (*Macropus robustus*) from Australia, presented by the Acclimatisation Society of Melbourne; two Audouin's Gulls (*Larus audouini*) from Sardinia, presented by Lord Lilford; a Kappler's Armadillo (*Tatusia kappleri*) from Surinam, deposited; two Musquashes (*Fiber zibethicus*) from North America, received in exchange; a Harpy Eagle (*Thrasaetus harpyia*) from Paraguay; seven Ariel Toucans (*Ramphastos ariel*) from Brazil, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), born in the Gardens.

SCIENTIFIC SERIALS

The current number of the *Journal of Anatomy and Physiology* contains several papers of interest. Dr. Binz commences with an article On some effects of alcohol on warm-blooded animals, in which he supports the non-heating action of alcohol, considering the subjective impression as partly the consequence of the irritation of the nerves of the stomach, and of the enlargement of the cutaneous vessels. The cooling effect of alcohol on febrile conditions is demonstrated and shown to depend on its direct diminution of the activity of the cellular elements of the body, on the increase of the cutaneous circulation which arises from strengthening of the heart's action, and in the diminution of muscular activity which follows its exhibition. —Dr. J. Blake continues his observations On the action of inorganic substances when introduced directly into the blood, endeavouring to show that in the same isomorphous group of elements, the intensity of physiological action increases as the atomic weight of the elements, but the relative atomicity of groups which are not closely related shows no corresponding gradation. The salts described on the present occasion are those of the alkaline earths.—Prof. Cleland discusses double-bodied monsters (kittens), and the development of the tongue in them, that organ being frequently found situated in the nasal passages, the palate at the same time being cleft.—Dr. C. Reyher described points connected with the cartilages and synovial membranes of joints, showing that the "synovial process," or portion of the synovial membrane which lies over the borders of the cartilages, is not to be looked upon as an ingrowth of the synovial membrane but as being formed *in situ* as the development of the joint proceeds.—Mr. Reoch endeavours to account for the presence of free hydrochloric acid in the gastric juice, the constant presence of which he gives experiments in proof of, on the far-fetched assumption that the oxidation of the sulphur which is contained in albumen takes place in the walls of the stomach; that the sulphuric acid thus formed decomposes the sodium chloride, liberating free hydrochloric acid to form part of the gastric juice. —Prof. Turner having had a second specimen of the Greenland shark (*Laemargus borealis*), is enabled to give an account of parts omitted in the original description, to be found in the same journal of the year previous. He gives a drawing of the animal, which was six feet long. It was male, and the sexual organs are described. The testes possess no vasa-deferentia, their products must therefore be shed into the peritoneal cavity, whence they reach the exterior water through the abdominal pores. The ureters were found to combine before they entered the cloaca by the single duct.—Prof. Savory has a paper On the use of the ligamentum teres of the hip-joint, in which he endeavours to prove the idea, which, as he remarks, had been previously suggested by the late Prof. Partridge and by Prof. Turner, that the body is slung on the two ligaments as a carriage is on C-springs. Prof. Humphry criticises Mr. Savory's results, restating his former remarks that the ligamentum teres is not tense in the erect posture.—Prof. Turner, in description of variations in the arrangement of the nerves of the human body, mentions a branch from the fourth cranial nerve to the orbicularis palpebrarum. In another instance the same nerve sent a branch to the infra-trochlear of the nasal. Peculiarities in the various plexuses are also noted.—A loquacious paper follows by Dr. Radcliffe on the syntheses of motion, vital and physical, in which it is attempted to be shown, that in muscle the state of rest is that of contraction, the state of action relaxation. —Mr. Ogilvie and Mr. Cathcart give the dissection of a malformed lamb.—Prof. Crum-Brown gives an ingenious explanation of the sense of rotation and its connection with the semicircular canals, connecting it with the inertia of their contents affecting the peripheral ends of the auditory nerves.—Dr. Brunton proves the value of external warmth in preventing death from an over-dose of chloral.—Mr. F. Champneys gives a detailed description of the septum of the auricles of the frog and the rabbit.—Mr. J. C. Ewart describes the epithelium in front of the retina and the external surface of the lens.—Dr. J. Ogle describes and figures a man born without legs.—Prof. Turner gives a drawing of the surface of the brain in its relation to the skull, which is followed by part of his paper on the placentation of the sloths, which we have noticed on a former occasion.—Notes on some muscular irregularities, follow, by Prof. Curnow; and the papers of the number end with three short notes by Mr. G. J. M. Smith, Mr. J. A. Russell, and Mr. Bellamy, on the dissection of an excised elbow, on unusually large renal calculus, three inches long, and a fusion of some of the carpal bones, repectively.

Bulletin Mensuel de la Société d'Acclimatation de Paris.—In his anniversary speech, reported in the Bulletin for April, M. Drouyn de Lhuys, the president, gives an interesting account of the victories of acclimatisation in the case of the coffee plant, the product of which, now universally esteemed, would never have been general but for its transplantation from its native home, Abyssinia, into other parts of Africa, into Europe, Asia, America, and those East and West Indian Islands which are now its best producers.—M. H. Bouley follows with an exhaustive paper on the subjection of animals by man to his own purposes. He analyses the various effects of food, of climate, of locality, of selection, and other influences on the natures of animals, and shows how our principal useful animals, such as the horse and the dog, have gradually, by dint of the constant exertion of various powers, been brought to their present state of subjection.—The annual report of the Society gives a retrospective glance at the year's work. Among birds the principal acquisitions have been varieties of pheasants, black swans, and Chilian geese. Among fishes, the telescope fish, the rainbow fish of China, and the *gourami*, are the most remarkable. Among plants, numerous Australian trees, acacias, and others; various kinds of bamboos; the *Eucalyptus*, fairly acclimatised in Algeria; and China grass, which promises to form a useful textile fabric, have been introduced.

Zeitschrift für Ethnologie.—Recent numbers of the *Zeitschrift für Ethnologie* have been continuing and concluding the series of papers in which its readers have been put in possession of a very minute summary of Col. Dalton's official report on the ethnology of Bengal, translated by Herr Oscar Flex, missionary in Ranshi. These valuable reports proclaim the remarkable dissimilarity which prevails in the domestic habits and national customs of tribes presenting strong linguistic and psychical affinity with one another. Thus amongst the Manipuris, who may possibly, however, be of Aryan descent, although they have long been followers of the religion of Brahma, and claimed him for their proto-genitor, the women enjoy perfect freedom, both in regard to their control of the household and their participation in games in which men take part; and although the husband may divorce his wife on good grounds, if he ventures to do so without valid reason the woman may leave him and appropriate to herself all his possessions, with the exception of a cup and his loin-cloth. These people also celebrate feasts at which meat is partaken of, contrary to the proscriptions of their present form of religion. Among the neighbouring Kukis no such practices prevail, the men drinking and smoking apart in their festive gatherings, and celebrating solemn festivals by visiting the graves of their forefathers to consult oracles and seek for omens. In the country of the Kasiâs, where Lieut. Bedingfield was murdered two years after its annexation to our Indian empire, monoliths and other stone memorials are common, and for the most part present great similarity to the menhirs and cromlechs of Cornwall and Brittany. The Garos, whose country lies west of Kasia and extends in the south and east as far as the Brahmaputra, are but little known beyond their own frontiers, while the mountainous districts of their settlements continue to be almost wholly unexplored. These tribes claim to be a primitive people, while, like the Brits, they pretend to have affinity with the English races.—Dr. J. G. Wetzstein gives an interesting account of the ancient Hebrew threshing board, still in use in Syria, where every village has its communal threshing ground to which the neighbouring landowners—both great proprietors and the small peasants—bring their grain, mostly on camels, to be prepared on these curious tables or boards. Dr. Wetzstein has laid before the Anthropological Society of Berlin a sample of the stones in use for this simple mechanical contrivance, which appears to be almost unchanged in its structure and mode of use from Biblical times to the present day, and may be seen amongst the Berbers, the Cypriots, and in other parts of Asia Minor, besides Syria.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 18. On the Employment of a Planimeter to obtain Mean Values from the traces of continuous Self-recording Meteorological Instruments, by Robert H. Scott, F.R.S.

The usual method of dealing with barograms and thermograms is to measure them at certain intervals by appropriate scales, and to treat the numerical values so obtained by arithmetical processes so as to arrive at mean results.

At the suggestion of Mr. Francis Galton, the Meteorological Committee gave instructions that measurements should be made of the curves by means of Amsler's Planimeter, in order to test the accuracy of unpublished means.

It is perfectly obvious that the measurement of the area of the curve, if it can be executed with sufficient accuracy, must give a far more satisfactory mode of ascertaining the value of the mean ordinate of the curve, than the calculation of the average of any number of measured individual ordinates, while the economy of time insured by the use of the planimeter forms a most important recommendation for its use.

The mode of employing the instrument is as follows :—The entire perimeter of the curve, down to the base line, is measured, and the value noted. Then *using the same base line*, a rectangle of known height, in units of the scale of the curve, is next measured in the same way, and the value noted again.

The ratio of these two values is the mean value of the ordinate of the curve, or the mean pressure or temperature for the interval embraced by the curve.

The table subjoined to the paper shows for a period of eight months the means of temperature for Kew Observatory obtained by the planimeter, as well as those yielded by the old method, both for daily and for five-day means. It will be seen that the difference in 242 determinations of daily means only amounted to 0°·5 on six occasions, and to 0°·6 in one instance, while out of 49 cases of five-day means the greatest difference was only 0°·4, and this was only once attained.

At the end of the table a column headed "Wr. Rep. Plates" gives the values obtained by measurement of the plates published in the "Quarterly Weather Report" for the period embraced by the measurements to which I have just alluded. It will be seen from it that the five-day means so obtained hardly differ from those which are yielded by the direct measurement of the photographic curve by means of the planimeter.

The plates in question are obtained by the use of Mr. Francis Galton's Pantagraph, which transfers the seconds at a reduced time-scale to zinc plates, which plates are subsequently further reduced and transferred to copper by Wagner's Pantagraph, as explained in the report of the Committee for 1870.

Such a test as this affords a satisfactory proof of the accuracy of the reproduction of our automatic records which are executed in the Meteorological Office.

The result of these preliminary experiments is that the planimeter means are practically identical with those obtained by treatment of the values of the hourly ordinates.

On the diuretic action of *Digitalis*, by T. Lauder Brunton, M.D., and Henry Power, M.B.

The object of this communication is to show that the diuretic effects which follow the exhibition of digitalis depend on the reactionary relaxation which follows the spasm of the smaller renal arteries consequent on the influence of the digitalis, instead of on the direct increase in the arterial blood-pressure, the direct effect of the drug.

An account of certain Organisms occurring in the Blood, by W. Osler, M.D.

In many diseased conditions, and sometimes in health, careful investigation of the blood proves that, in addition to the usual elements, there exist pale granular masses, which on closer inspection present a corpuscular appearance, varying in size from a quarter that of a white blood-corpuscle to enormous masses, with an oval or rounded form, sometimes elongate or irregular. The author watches these bodies at a temperature of 37° C. and finds that they undergo remarkable changes. At first uniform and still, Brownian movements soon commence ; fine projections from the mass develop ; its edges become less dense, more loosely arranged ; semi-free minor corpuscles form, which quickly break away, moving independently in the fluid. Other filaments undergo the same change, fresh detachments becoming so numerous as to fill the field of the object glass. Granules present themselves in abundance. The original mass has now become perceptibly smaller and more granular. The variety of the forms increases as the development goes on ; and whereas at first spermatozoa-like or spindle-shaped forms were almost exclusively to be seen, more irregular forms appear later, possessing two, three, or more tail-like processes. It is to be noted that in blood without the addition of saline solution or serum, no change takes place in the corpuscles under consideration, even after prolonged warning. It must still be confessed that we know nothing of the origin or destiny of these corpuscles ; they evidently cannot arise from the disintegration of white corpuscles, for they form individual elements circulating through the blood.

On Coniferine and its Conversion into the Aromatic Principle of Vanilla, by Ferd. Tiemann and Wilh. Haarmann. Communicated by A. W. Hoffmann, F.R.S.

Given the number of figures (not exceeding 100) in the reciprocal of a prime number, to determine the prime itself, by William Shanks. Communicated by the Rev. G. Salmon, F.R.S.

Description of the living and extinct races of gigantic Land Tortoises. Part I. and II. Introduction, and the Tortoises of the Galapagos Islands, by Albert Gunther, F.R.S.

The author having the opportunity of examining remains of tortoises from the Mascarene Islands concludes that the several extinct gigantic species are different from the more recent ones, and that there is the greatest resemblance between the tortoises of the Mascarene and Galapagos Islands. An historical account is given, which shows that the presence of these tortoises at two so distant stations cannot be accounted for by the agency of man, at least not in historic times, and therefore that these animals must be regarded as indigenous. The second part contains a description of the Galapagos tortoises.

EDINBURGH

Scottish Meteorological Society, July 2.—This was the Half-yearly General Meeting of the Society ; the Marquis of Tweeddale, president of the Society, in the chair. The report was read by Mr. Milne Home, chairman of the Council, from which it appeared that the Society's stations number at present 104, of which 92 are in Scotland, and that the Society consists of 558 ordinary, 15 corresponding, and 8 honorary members. Observations are made at fourteen stations in Scotland at 12.43 P.M., in connection with the International scheme of Meteorology. The Hon. B. Primrose, secretary of the Fishery Board, who had entered with much zeal into the inquiry into the relations of meteorology to the herring fishery, having intimated that if the Society would furnish the necessary instruments he would endeavour that twenty sets of observations of sea temperature should be carried on during the fishing season, the Marquis of Tweeddale has liberally provided the instruments required. Dr. Arthur Mitchell stated that the Ozone Committee had resolved publicly to invite investigators to submit to them any scheme which in their opinion would increase our knowledge of ozone, and which they were desirous to prosecute if asserted. It is hoped that some line of inquiry likely to lead to satisfactory results will soon be suggested, and whenever this is done the Committee will be prepared to give assistance out of the fund of 100*l*. placed at their disposal by the munificence of the noble President. Dr. Arthur Mitchell and Mr. Buchan read a paper on the influence of seasons on human mortality, which we hope to give next week. Mr. Ballingall, Islay, exhibited and described a new pressure anemometer, invented by him. The instrument consists of a measured surface, which, exposed to the wind, registers its force by means of an index, acted upon by a wooden plunger in a bath of mercury. Mr. Thomas Stevenson, C.E., described a portable barometer made of malleable iron, which he suggested for portable purposes. The instrument also contained an ingenious arrangement suggested to him by Mr. E. Sang. Iron will also be very suitable for water or oil barometers in which a very large scale is desirable for showing sudden changes in the atmospheric pressure, the accurate observations of which are likely to grow in importance from year to year.

BERLIN

German Chemical Society, June 8.—C. Rammelsberg, president, in the chair.—G. Langbein described the manufacture of iodide of potassium from iodide of copper, containing 60 - 66 per cent. of iodine, which is now largely imported from Peru. It is transformed into HI by treating it with SH_2 and then saturated with carbonate of potassium.—J. Thomsen maintains his view against that expressed by Berthelot, who believes the existence of definite hydrates of acids and alkalis to be proved by the heat of combination.—M. Nencky, by heating acetate of guanidine, has obtained a new monoatomic base, guanamine, of the formula $C_4N_5H_7$.—The same author has obtained a direct combination of oxalate of ethyl with sulpho-urea.—K. Heuman communicates observations on cinnabar. Light transforms it into the black modification, particularly when obtained by precipitation. Metallic copper at 100° separates mercury from it in the metallic state.—C. Liebermann, by treating benzoyl-benzoic acid $C_{14}H_{10}O_3$ with sulphuric acid, has transformed it into anthracen-sulphuric acid.—A. W. Hofmann has investigated residues of the aniline manufactory of M. Weiler in Cologne, consisting of pure phenylene-diamine.—K. Wippermann publishes new investigations on the condensed hydrocyanic acid $C_3N_3H_3$ lately obtained by Lange. It is always formed when hydrocyanic acid is kept with a small quantity of alkali, and then distilled. It is extracted from the residue by ether. Hydrate of baryta transforms it into glycocol. Its formula appears to be $N \equiv C - C(NH_2)H - C \equiv N$, the nitrile of amido-malonic acid.—H. Schiff assigns the formula of a dilaureate of glycerine to the fat of laurel, which has hitherto been considered as a derivative of allylic glycol.—L. Henry proves the formula of lactide to be doubly as large as has been admitted until now $= (C_3H_4O_3)_2$.—The same chemist described derivatives of propargyl C_3H_3 with Br, Br_3 and Br_5, of chloride of allyl with HBrO and of chloral with monochlorhydrin of glycol.—C. Kaiser showed a set of very exact weights cut in rock crystal and obtained from the manufactory of Hermann Stern in Oberstein, near Kreuznach.

PARIS

Academy of Sciences, June 29.—M. Bertrand in the chair.—Gen. Morin communicated to the Academy a telegraphic despatch from the Emperor of Brazil, sent from Rio de Janeiro on June 23, and received in Paris on the 24th.—The following communications were read:—On a new property of metallic rhodium, by MM. H. Sainte-Claire Deville and H. Debray. When iridium and rhodium are precipitated from their solutions by formic acid or alcohol, the finely divided metallic powders possess remarkable properties. The rhodium thus obtained decomposes alcohol (in presence of alkali) hydrogen being liberated and an acetate produced. Formic acid is decomposed by the same substance into carbon dioxide and water. Platinum and palladium in the same condition do not attack formic acid, while iridium and ruthenium act like rhodium.—M. A. Ledieu presented the concluding portion of his researches on the theory of the collision of bodies with consideration of atomic vibrations.—On the spectra of vapours at high temperatures, by Mr. J. N. Lockyer. This paper contains the results of experiments already communicated to the Royal Society and published in NATURE.—Report on the state of the preparations for the expeditions sent by the Academy to observe the transit of Venus on Dec. 9, by M. Dumas.—Report on the administrative measures to be taken for the preservation of territories threatened by *Phylloxera*, by the Commissioners. It is suggested to the Academy that a special law should be made compelling proprietors to declare the first appearance of the scourge, that experts should then be appointed to examine into the state of the infested vines, and that these should be destroyed when thought necessary by ministerial decision, the proprietor receiving adequate compensation. It is further suggested to destroy the vines surrounding the districts actually invaded, to disinfect the soil by chemical methods, and to burn the cuttings, leaves, and roots of the diseased plants as well as the plants themselves in the same district where the uprooting has taken place, and finally to prohibit with the utmost rigour the exportation from infested territories of anything that might serve as a vehicle for the insect.—M. Heis communicated a letter sent by him to M. Faye concerning the studies recommended to the observers of the forthcoming transit of Venus. The author suggests the observation of meteors and the zodiacal light with respect to colour, intensity, form, &c.; also of the milky way and of polar auroras.—On the temperature of the sun, by M. J. Violle. The author gave a description of the apparatus employed by him in this inquiry. A determination made at Grenoble on June 20 at 3.30 gave the temperature 1,354°, but to get at the true temperature of the sun this number must be corrected for atmospheric absorption and other causes. To eliminate these errors the author has made several ascents of the Alps, but the results are not yet made known.—Some remarks were made on the foregoing paper by M. H. Sainte-Claire Deville, and M. Berthelot communicated a paper *à propos* of these remarks entitled "On high temperatures."—On the application of carbon disulphide mixed with tar and with alkalies for the destruction of *Phylloxera*, by M. C. Monestier.—M. Lecoq de Boisbaudran communicated a note on the use of carbon disulphide for the same purpose.—On a point in the theory of functions, by M. Halphen.—Geometrical integration of the equation $L(xdy - ydx) - Mdy + Ndx - O$, in which L, M, and N designate linear functions of x and y, by M. Fouret.—New method for determining the index of refraction of liquids, by MM. Terguem and Trannin. The authors gave a description of their apparatus and some of the results obtained by it.—On electro-static phenomena in voltaic batteries, by M. A. Angot.—On the evaporation of liquids at temperatures above their boiling points, by M. de Gernez.—On new apparatus called *accelerometers*, for the study of the phenomena of the combustion of gunpowders, by MM. Deprez and H. Sebert.—Note on an intestinal calculus of the sturgeon, by MM. Delachanal and Mermet.—Results of the employment of phenol in burials, by M. Prat.—On the publication of the observations of meteors made by M. Coulvier-Gravier, a letter from M. Schiaparelli.—On the structure of the caudal appendage of certain ascidian larvæ, by M. J. Giard.—On the presence of lead in the brain, by M. Daremberg. This was found after cases of lead-poisoning.—M. Chatin was elected during the meeting to supply the vacancy in the botanical section caused by the death of M. C. Gay.

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THURSDAY, JULY 16, 1874

SCIENCE IN THE SHOWYARD

IT is difficult to over-estimate the benefits which practical agriculture has derived from the great country meetings of our Agricultural Societies. Shifting from year to year to different parts of England these annual exhibitions have brought the general progress of agriculture to bear in a direct manner upon local practice, and made the country farmer acquainted with the improvements that have originated in distant centres of activity; while at the same time the peculiar excellences of the district visited are prominently brought to light, and give their own distinctive character and teaching to the exhibition. The beneficial influence of such Agricultural Shows is much increased when, as in the case of the show now being held at Bedford, they are conducted by a first-class Society. Not only are the exhibitions in this case of greater number, and superior quality, but the character of the judging is superior also, and science is really brought to bear in awarding the prizes in the various classes. To refer to the present show of the Royal Agricultural Society at Bedford, the official lists tell us of the vast number of agricultural implements entered for competition, the class of drills alone including 135 entries. Every one of these implements, before this article is in type, will have been carefully tested by actual work in the field; the quantity of power required to produce a certain amount of work will have been ascertained by a dynamometer contrived expressly for the purpose; the construction of each implement will have been thoroughly criticised; and finally, its merits in each department of its work will have been expressed by an elaborate system of marking. The reports of these trials will in due course appear in the Society's Journal, and the farmer will obtain a valuable mass of information on the subject of implements such as no private individual could have given him. Anyone who desires to see how thoroughly the work of judging is done, and what wonderful skill is now brought to bear on the construction of agricultural machines, should read the two reports on Portable Steam-engines and on Ploughs and Harrows in the last volume of the Royal Agricultural Society's Journal. There can be no question of the immense benefit resulting to practical agriculture from such exhibitions, and from the publication of such reports.

Another chief item in Agricultural Shows, and perhaps the most attractive, is the live stock. The non-agricultural public has seldom any notion of the points aimed at by an intelligent breeder of stock, and those who have never attended one of the country meetings of our great Agricultural Societies may very likely expect to see a mere collection of fat beasts. Our agricultural readers well know that this is far from being the case. Bulk is by no means the object which the breeder has in view; his aim is the production of an animal perfect both in form and quality, and fitted in the highest degree for the various purposes which it is intended to serve. The same principle is also steadily kept in view by the judges, who are instructed by the Society to form their decisions entirely on the animal's character for breeding purposes, and not on its present fitness for the butcher. We need hardly say that our Agricultural Shows have had a large share in that wonderful improvement of our various breeds of stock which has taken place to such a marked extent in recent years.

The subject of the varieties and breeds of cattle is full of interest; indeed we hardly know a more instructive field for the naturalist's study than that presented by the showyards of our Agricultural Societies. Here he will meet with abundant and striking instances of what may be effected by artificial selection persistently carried on with a definite purpose in view; and here also he will meet with equal evidence of the great influence of climate and other ill-understood conditions, which put a limit to the possible work of the breeder, and confine certain varieties to certain districts. That so small a country as Britain should have so many distinct breeds of sheep and cattle localised in different parts of the island is certainly remarkable, and the subject becomes more interesting when we find that in many cases these local breeds cannot be maintained true to their character if transported to other parts of the island. Thus we have in Lincolnshire a breed of sheep remarkable for their long glossy wool. Many attempts have been made to establish flocks of these sheep in other parts of England, but as far as we are aware the peculiar gloss of the wool has always disappeared after a few years.

The effect of external conditions on the character of an animal becomes still more apparent if, after making acquaintance with British sheep and cattle, the naturalist crosses the sea and pays a visit to a continental agricultural show. The British farmer who visited the Vienna Exhibition last year must have stared with wonder at the collection of animals there displayed. He would probably regard with contempt the long-legged, woolly pig, with large and powerful snout, quite unlike the inhabitants of his own styes; but when he learnt that the Transylvanian pig spends its life in the forest, and in winter time has to grub for its food through a foot or more of snow, the British visitor would begin to perceive that the animal is really far better fitted for such a life than his own favourite "Berkshire;" and he would be prepared to hear that English pigs in such districts have proved a failure. Equally remarkable to an Englishman would appear the curious Merino sheep, bred entirely with a view to wool, but worthless considered as mutton, and the fine Hungarian draught oxen, admirably fitted for hard work and hard living, but which no amount of cake would turn into beef at two years old. These would be striking examples of the effect of artificial selection and natural conditions in producing different kinds of excellence from those aimed at in our own country.

In our autumnal shows the naturalist's attention might be directed with equal advantage to the influence of cultivation on the characters of the various seeds and roots exhibited. It is not so very long ago that the first Swede and the first mangold were introduced into this country; the varieties are now endless, and there is probably now quite as much difference between the roots originally imported and their modern representatives as between the greyhound-like swine one sees in old engravings and the present English examples of the race. Artificial selection has, in the case of roots and seeds, taken a wide scope, endeavouring to supply the very various wants of the farmer. Varieties suitable for early and late growth, and for various descriptions of soil and climate, are aimed at, and in many instances produced. The advantage of having a continual supply of *new* varieties appears in some cases to be considerable; thus in the case of the potato disease it seems generally acknowledged that a recently introduced kind resists disease far better than an old sort. Varieties cannot, however, as is well known, be trusted to maintain their character; fresh seed must constantly be employed, and the process of selection must continually be maintained. The trade of the seedsman is thus one of never-ending use and importance. Perhaps one of the most striking recent instances of what may be effected by cultivation with a definite object is afforded by the case of sugar-beet. Beetroot contains somewhere about 8 per cent. of sugar; cultivation, however, and suitable manuring have so increased this percentage that sugar-beet now yields 12-14 per cent. of sugar in the average of seasons, and in favourable seasons 17 per cent. is sometimes reached. We need hardly point out that the practical influence of Agricultural Shows is again most useful in bringing under the farmer's notice both the new varieties raised in this country and the new species introduced from time to time abroad.

The Royal Agricultural Society has lately gone a step beyond the usual limits of the showyard, and has taken advantage of its country meetings to offer prizes for the best-managed farm in the surrounding district. This is undoubtedly a step in the right direction. Hitherto the teaching of the Agricultural Show has been pretty much confined to the subjects of live stock and implements. Certain portions of the farmer's work have been exhaustively illustrated; but farming as a whole has scarcely been dealt with. Might we suggest that the Royal Agricultural Society should go still further in carrying out its admirable motto, "Practice with Science," and endeavour to make its country meetings yet more effective in diffusing true knowledge. Why should not the Society arrange for two or three public lectures in the show-week, to be given by persons eminent in science or in practical agriculture? How much valuable teaching might thus be imparted. The Royal Agricultural Society has already exerted itself in the cause of scientific education for the sons of farmers, and has continued this work in the face of considerable opposition; let it enlarge its good work still further, and aim at teaching the farmers who are annually gathered at its Agricultural Shows.

COLONIAL GEOLOGICAL SURVEYS

II.—VICTORIA

Geological Survey of Victoria—Report of Progress. By R. Brough Smyth. (Melbourne, 1874.)

MR. SMYTH must be a shrewd and clever person. He has one of the most difficult tasks to perform—to persuade or cajole a Colonial Government or Assembly which knows nothing and cares still less about anything scientific, to vote money for a scientific object and to take some interest in having that object carried out. Not many years ago Victoria had a regular Geological Survey, equipped at the colony's expense and directed by Mr. Selwyn, who now so ably conducts the great Survey of Canada. For some reason which we have heard variously described, but which seems to have lain to some extent at least in official jealousies and in differences of opinion as to the degree in which geological research as opposed to mere mineral prospecting should guide the progress of work, the Victorian Survey came to an end and its officers were left to seek employment elsewhere. At the same time the Department of Mines in the colony showed great activity in collecting mining and geological information, the prime mover in this being the secretary, Mr. Brough Smyth. When the Geological Survey ceased to exist he seems to have thrown himself more into a geological line. With no little sagacity and tact he gradually organised a less ambitious scheme for having the country geologically surveyed. He obtained the services of one or two members of the previous Geological Survey, and, with a small grant from the legislature, began to make a geological examination of some of the mining districts, and to prepare maps and sections to show their structure. Under the wing of the Mining Department he evidently could do a good deal without placing a formal vote for a Geological Survey service on the colonial estimates.

How much soever a man may have science at heart, in such a population as that of Victoria he can hardly hope to find much encouragement for science pure and simple. It is needful for him to show some practical utility in his work before he can expect to receive aid, especially of a pecuniary kind. Fortunately in Victoria one great element in the national wealth lies in mining. Anything therefore which tends to increase the value of mines, or to lead to the discovery of fresh mineral fields, appeals at once to the feelings of the colonial legislators.

Mr. Smyth indeed in the present Report grows very bold, going even so far as to assert that the main object of the survey should be scientific discovery, any practical benefit arising from the work being a sort of secondary and accidental circumstance. He takes good care, however, to bring the practical benefits well into the foreground, so that we imagine his superiors are not likely to quarrel with his theory so long as he adheres to his present practice. It would, indeed, be very short-sighted policy to interfere with him. He is unquestionably right in endeavouring to place the knowledge of the mineral structure of the colony on a sound basis of scientific exploration. There may perhaps be no apparent pecuniary return for the outlay at first, but the money expended as he is expending it will assuredly in the end be repaid tenfold. It will save a vast amount of expense in enabling colonists to decide where to begin their mineral ventures and in pointing out where no possible outlay could be profitable. It will stimulate the development of the mineral wealth of the country, and thus add directly and largely to the national prosperity.

We do not notice much of geological novelty in this Report of Progress, though some of the details are interesting, particularly in regard to fresh illustrations of the wonderful volcanic history of some of the goldfields, and to certain of the fossils which have been obtained in recent explorations. A list of all the fossil species hitherto obtained in the colony is inserted in the Report, and forms, so far as we know, the first list of the kind which Victoria has furnished. A considerable proportion of the species is from Upper or Lower Silurian rocks. A few are Devonian and Upper Palæozoic. With regard to Secondary and Tertiary rocks, Mr. Smyth very properly avoids identifying his formations with those of Europe, and contents himself with indicating such indefinite horizons as Lower and Upper Mesozoic. The list of publications on the mines and geological structure of Victoria is already a tolerably long one, and indicates no small amount of activity. It includes Mr. Smyth's work on the "Goldfields of Victoria," which we favourably noticed at the time of its appearance.

Easy-going geologists in this country, who spend their winters comfortably in town, and can at any moment transport themselves by train or steamer to even the farthest parts of the kingdom, have little notion what geologising is in an unexplored region like that of so vast a portion of Australia. Mr. Smyth, for instance, in the most matter-of-fact way refers to one part of geological work in Victoria as "cutting tracks," that is, levelling the trees and scrub in a densely-timbered region so as to make a roadway into the wilds. He truly adds that every mile of such road-cutting is a gain of so much territory to the colony. We find that during three months of last year the survey spent 172*l.* 16*s.* 6*d.* in cutting tracks, each of which was of course a geological section.

But while all this work is going on in his own colony, Mr. Smyth's energies extend over the whole of his continent. At his suggestion, representations have been made to the authorities of the other Australian colonies, to aid in the preparation of a general geological map embracing the whole of Australia and Tasmania. This proposal having been favourably received, considerable progress has been made in the preparation of the map. Mr. Smyth remarks however, that no response has been received from New South Wales, which still remains a blank on his map. No explanation is given of this not very intelligible statement. Certainly there is abundance of information to be had regarding the geological structure of that colony, where, among others, the veteran W. B. Clarke has laboured so long and so well.

As an illustration of the thoroughness with which the Department of Mines endeavours to do its work, it may be mentioned that specimens of rocks or minerals which may be sent up from any part of the country are examined, and if need be analysed, a boon which appears to be taken advantage of to a considerable extent. Appended to Mr. Smyth's Report of Progress is an excellent Report on the Mineral Resources of Ballarat, by R. A. F. Murray, who we believe was one of Mr. Selwyn's staff. The appendix contains also reports on some of the colonial coalfields. In conclusion, it should be added, that this Report is admirably, indeed almost luxuriously, printed and illustrated, presenting a very striking contrast to the blue-books we are accustomed to at home. Mr. Smyth deserves great credit for the way in which he has organised his work, and we trust that a long series of excellent reports may be obtained from him. ARCH. GEIKIE

THE FISHERIES OF NEW ENGLAND

Report on the Condition of the Sea Fisheries of the South Coast of New England in 1871 *and* 1872. By Spencer F. Baird, Commissioner. (Washington: Government Printing Office, 1873.)

WHILE the question of the supply of fish to the English markets is being year by year more anxiously discussed, and measures taken for the restoration of those fisheries which have been decimated, and for the protection of those whose productiveness is threatened by overfishing, our Transatlantic brethren are engaged in the investigation of a similar question in connection with the produce of their own waters. The wonderful fertility of fish, and the apparently inexhaustible supplies to be found in the waters of all parts of the world, have given rise to the idea that there is no limit to their abundance, and that no appreciable diminution in their numbers can be effected by the most unrestricted fishing. The experience afforded by the example of the salmon fisheries of this country has shown the fallacy of this idea. The most productive rivers have been reduced to absolute unproductiveness, and the most stringent measures have been adopted for encouraging the growth and restricting the destruction of fish. Overfishing, it is found, is not only possible, but has a very speedy effect on the natural supplies; and already the people on the other side of the Atlantic are experiencing the truth of this fact. Notwithstanding the enormous seaboard possessed by the United States, it is found that the supplies of fish are no longer equal to the demand, and the most important fish-producing States have consequently instituted inquiries with the view of adopting remedial measures. Opinions on no subject are more varied and contradictory than on the question of fish supplies. This is inevitable, as comparatively little is known of the habits of fish, and persons are too apt to generalise upon the result of their own limited experience. Finding the testimony of various authorities too conflicting to be of any use, the State of New England appointed Prof. Baird, of the Smithsonian Institution, to make a detailed inquiry into the condition of the fisheries on the coast and lakes of the country generally. The present report is the result of his first year's operations.

Anyone conversant with the fisheries of this country cannot fail to be struck with the similarity that exists between their condition and that of the American fisheries. The river fisheries of England had long been falling into decay, and were almost annihilated, when measures were adopted for their restoration. The river fisheries of America have also fallen off in productiveness, the only astonishing feature being the suddenness of this decay. There are many causes, such as the existence of pollutions, of obstructions, and of navigation, that have militated against the fisheries of this country which have not had equal force in America; but the principal cause of decay has acted more speedily there, and it is apparent that overfishing, and the destruction of spawning fish, have been on both sides of the Atlantic the chief enemy to the continued prosperity of river fisheries. Here salmon, there bass, have been trapped both in their upward and downward progress in the rivers, and no "close season" has been allowed in which they might, unmolested, perform their natural functions of reproduction. In England "fixed engines," *i.e.* devices fixed in the run of the fish, and intercepting almost every individual that would attempt to pass them, have been abolished. In America these instruments are more largely used than ever they were here; and a glance at the diagrams presented by Mr. Baird shows their terribly destructive nature. In some rivers, and on some parts of the coast, they are placed so thickly that no fish can pass them; and, as they are *in situ* all the year round without intermission, it is no wonder that the fisheries are decreasing in value. The total abolition of these engines is suggested as the only real remedy. But the Commissioner is afraid that such a regulation would entail great loss on the owners of such instruments, and would also suddenly interfere with the supply of fish to the public. These traps can fish without human help, while the more legitimate fishermen's nets and gear can only be employed in suitable weather. He recommends that an interval of sixty hours every week should be enforced, during which the use of traps and pounds should be absolutely interdicted; that an annual close time of fifty-six days, viz. from April 20 to June 15, should be established, during which the use of such engines should be prohibited; and that the licensing system adopted in England should be introduced.

This is certainly a step in the right direction, but we venture to think that a diminution in the number of fixed engines would be advisable, and that such diminution should be partially enforced at once, and be gradually continued till the whole of these instruments are abolished. This need entail very little hardship on individuals, and would certainly not interfere with the regular supply of fish to the markets, while the eventual increase would more than justify the enactment.

In regard to the more purely sea fisheries, the similarity between the British and American fisheries is equally striking, while at the same time the rapidity with which the produce of American waters has fallen off is still more marked. On the English coasts the fisheries are continually fluctuating, but in no part does the diminution in the capture appear to have been so great and so permanent as it is recorded to be in America. The curious extracts from works of two hundred years ago testify to the great natural abundance of fish in the seas adjoining to the American shores; and, to come to more recent years, the printed evidence of living fishermen clearly shows that, for some reason or another, the sea fisheries, like the river fisheries, are much less valuable than they were thirty years ago.

The principal fishes of the coast to which the volume more particularly refers are the "blue fish" (*Pomatomus saltatrix*), also called "horse-mackerel;" the "scup" (*Pagrus* or *Stenotomus argyrops*), "squeteague" (*Cynoscion regalis*), a species of bream; "menhaden" (*Brevoortia menhaden*), a species of herring; sea bass and striped bass (*Roccus* or *Labrax lineatus*); mackerel (*Scomber scombrus*), similar to the common European mackerel; "tautog" or black fish (*Tautoga americana*), of the *Labridæ*, or wrasse family; herring (*Clupea harengus*), and cod, both of the well-known species. Of these, the principal diminution has been found to have occurred among the blue fish, the bass, the scup, and the tautog. The former of these is a very voracious fish, rivalling the shark in its powers of destruction, so much so that to its agency has been ascribed the diminution of other kinds of fish in localities where it is generally caught. But since it has itself greatly diminished, it is hardly possible that the decrease of other fish is attributable in any degree to the depredations of one predaceous kind.

Besides the above there are many other kinds of fish, more or less valuable as food, and sought after also on account of the oil they yield, and for the purposes of utilising them as manure, a complete list of which is given by Prof. Baird. This list is most valuable as condensing and correcting the various imperfect catalogues that have from time to time been made, and as exemplifying the natural richness and fertility of the seas on the seaboard of the Eastern States. As an instance of the extreme difficulty of accounting accurately for the increase and diminution in the capture of fish, we may quote the unexpected appearance of a species of Tunny, a kind of small horse-mackerel (*Orcynus thunnina*), which, though never previously recorded as having been caught on the American coast, was found in great abundance in Menemsha Bight by the Commissioner. The movements of fish are far more difficult to watch and to account for than those of land-animals, and great difficulty is experienced in following them. On some occasions a certain kind of fish has been very abundant in one locality, while a short distance away it has been very scarce; and one fishing-ground has been deserted one year, to be visited by large numbers the next year. One fallacy concerning the movements of the American migratory fish seems quite exploded. To quote Prof. Baird:—

"It was formerly supposed that certain fish, as the herring, the shad, and the alewives, with others of like habits, prosecuted an extensive migration along the shores of the ocean, covering, sometimes, thousands of miles in the sweep of their travels; and much eloquent writing has been expended by such authors as Pennant and others in defining the starting-point and terminus, as well as the intermediate stages of the voyage. The shad, too, which, as is well known, occupies all the rivers of the Atlantic coast from Florida to the Gulf of St. Lawrence, was thought to begin its course in the West Indies, and in an immense body, which, going northward, sent a detachment to occupy each fresh-water stream as it was reached, the last remnant of the band finally passing up the St. Lawrence, and there closing the course. We now, however, have much reason to think that in the case of the herring, the shad, the alewife, and the salmon, the journey is simply from the mouths of the rivers by the nearest deep gully or trough to the outer sea, and that the appearance of the fish in the mouths of the rivers along the coast at successive intervals, from early spring in the south to near midsummer in the north, is simply due to their taking up their line of march, at successive epochs, from the open sea to the river they had left during a previous season, induced by the stimulus of a definite temperature, which, of course, would be successively attained at later and later dates as the distance northward increased."

It seems pretty well established that, with the American migratory fish, which enter fresh water to spawn, as with the English salmon, the same individuals pass as nearly as possible to the same river, or at least to the same locality, and the same rule applies to their progeny—the young fry appearing to return to the river in which they were hatched.

Of these migratory fish the salmon has been well nigh exterminated, and the shad alone appears to keep up its numbers. Whether or not this is altogether owing to the exertions of the fish culturists, who have hatched artificially many millions of these fish and turned them into the various rivers, it would be rash to say positively; but no doubt this means, and the erection of suitable fish-passes to enable the fish to surmount the weirs, have had a large part in effecting this result.

As regards the practical protection of fisheries, whether in sea or river, the case of the Americans is almost identical with our own; and the remedies to be adopted must be the same in both countries. As regards the scientific side of the question, relative to the habits and distribution of fish, there is much that is new and valuable in the Commissioner's report. Indeed, the greater share of the volume is devoted to such questions, and to the scientific classification, not only of fish proper, but of the various other forms of life found in the waters, and important as either providing food for the useful fishes or as preying upon them.

The various invertebrate animals which form the principal diet of fishes appear to exist in profusion, so that the scarcity of food-fishes cannot be attributed to the want of natural sustenance. Some of these animals which serve as a prey to fish when young, in their turn become aggressors when full grown. An interesting account is given of the destruction caused by various kinds of *Cephalopoda*, which commit great havoc amongst the schools of mackerel and herring. In attacking the mackerel "they would suddenly dart backward among the fish with the velocity of an arrow, and as suddenly turn obliquely to the right or left and seize a fish, which was almost instantly killed by a bite in the back of the neck with the sharp beaks;" and yet these same "squids," when young, themselves afford abundant and favourite food to fish.

The subject of sea-bottom is nowhere of such importance as where oysters exist, and Prof. Baird's researches on this point are most valuable. His remarks, which we have not space to quote in full, might be studied with advantage by those who are interested in oyster culture in England and in France.

Nearly 300 carefully executed engravings of the rare and more valuable forms of invertebrata conclude a volume of which but a faint outline has been given.

BALDWIN'S "IRISH FARMING"

Introduction to Irish Farming. By Thomas Baldwin, M.R.I.A., Superintendent of the Agricultural Department of National Education in Ireland, &c. (London: Macmillan & Co., 1874.)

IT is only by the spread of thorough technical education among our farmers that the most will ever be made of the comparatively small area which in these islands can be devoted to agricultural purposes; only by a scientific knowledge of the material with which he deals will the farmer be enabled to improve to the utmost the quantity and quality both of his crops and live stock. By careful selection and suitable feeding vast improvements have within recent years been made in the quality of the latter commodity, and by a scientific study of the various kinds of crops, of soils, and of manures, natural and artificial, rapid progress is being made in forcing "the earth to yield her increase" in greater and greater quantity and of richer and richer quality. No doubt as the reign of science becomes more and more universal, farming, like all other human pursuits, will be followed with more and more of skill founded on accurate scientific knowledge, and will become gradually less a matter of blind rule-of-thumb. In many instances this is the case in Great Britain and in Ireland even now, many of our farmers bringing to bear upon their pursuit a knowledge of the results of the most extensive and exact scientific investigation. It will be long before such an intelligent knowledge becomes universal, we fear; and meantime such manuals as Mr. Baldwin's are of use in spreading among farmers, large and small, who have had no technical training in their occupation, a knowledge, conveyed in popular language, of what can be attained by scientific or skilled farming.

The work comprehends much in comparatively small compass. It treats first of manures, and the necessity of their application to supply the waste in the land caused by cropping. Without going deeply into the chemical properties of soils and manures, it affords plain directions which the unscientific man can clearly understand and appreciate; and considering the general character of the large class which the author essays to enlighten, he has taken the most efficient method for attaining his purpose. His remarks on farmyard manure are just, but he might have expressed his preference for covered yards more strongly, as, besides other advantages, these preserve the manure from rain-water; and, where fodder is in plenty, the liquid is absorbed and utilised in a way which it cannot be to equal advantage when applied by itself. It is well ascertained that dung made in such yards is much richer than in ordinary yards, as from being gradually compressed by the treading of the cattle the ammonia cannot escape, nor any appreciable waste occur. The author's estimate of the quantity of the manure made from one cow in the year at twelve tons is certainly too great if quality as well as quantity is desired.

The second chapter is devoted to the culture and management of green crops and cereals, including potatoes, carrots, turnips, mangold, &c., and the ordinary corn crops. Specific directions are given as to what kinds to sow on particular soils, and how to manage them in the fields and in storing them, each variety being specially referred to in its comparative productiveness and utility. The author's remarks on hay-making are well worthy of perusal. There is no crop so mismanaged as this, especially in Scotland, and considering its extent and value, no censure can be too strong on the negligence and want of skill so generally manifested in securing it.

The third chapter is devoted to live stock, and here the author seems to have studied the various phases of breeding and fattening with a practical eye. Ireland is peculiarly well fitted for rearing stock, and the yearly supply it affords to Great Britain is marvellous. With a moist climate and an alluvial soil, the Irish farmers possess facilities in their fresh swards and luxuriant green crops which we do not possess on this side of the Channel; until at all events we go across the Tweed, and not even there in sufficient breadth and measure, for permanent grass meadows are seldom to be seen. The quality of the various breeds of cattle and sheep is discussed; but it must be remarked that a great complaint on this side of the Channel is made as to the want of quality and growth in much of the supply afforded us; this is no doubt owing principally to the careless selection of breeders, and to too much indiscriminate crossing. The author's remarks on poultry deserve special attention, not that he says anything peculiarly novel, but he treats the subject so plainly and in so much detail, that practical use can be made of his directions on a hitherto too much neglected point in rural economy.

In Chap. IV. examples are given of successful farming, both in large and small holdings, which all interested would do well to peruse. With industry and skill based on scientific knowledge, the productive power of the soil is astonishing. We see this more especially in the arid and sandy ground in Belgium, where two or three acres produce is sufficient for the support of a family. Steam ploughing, no doubt, is an equivalent for spade husbandry in stirring and pulverising the soil, but the personal exertions and superintendence of the cottager in thorough tilling, in careful seeding, successive cropping, manuring, weeding, and harvesting, cannot be excelled or equalled in substantial production. There is, moreover, in Scotland at all events, a degree of comfort and healthy sturdy appearance among that class, now perhaps too limited in number, which bears a striking contrast to the beer-drinking artisan and his wan shrivelled children in towns.

The author concludes with a chapter on cottage-gardening, which may be profitably studied by those of more pretension than the mere cottager. In England the taste for decoration and utility in small gardening is much more manifest than in Scotland, where little else than Scotch kail and weeds are, as a rule, to be seen. Mr. Baldwin has, on the whole, done ample justice to the various subjects he has treated, while the scope of his work is sufficiently comprehensive for the guidance of those who need instruction; and most farmers do, be their rural occupation of small or large compass.

We hope that the spread of works of this class will pave the way for the general circulation among farmers of works of a much more technical and scientific kind, and that ere very long, through the exertions of the Agricultural Societies, both of England and Scotland, Agricultural Schools will be established in convenient centres both in England, Scotland, and Ireland, by means of which the British farmer will be at least on as good a footing as the farmer on the Continent of Europe and in America.

OUR BOOK SHELF

Elementary Dynamics, with numerous Examples. By W. G. Willson, M.A. (Calcutta: Thacker, Spink, and Co.)

Principles of Mechanics. By T. M. Goodeve, M.A. (Longmans' Text-books of Science.)

THE first work on our list does not aim at a novel exposition of principles, though it differs from the ordinary text-books in use amongst junior students. Notes originally put together by the author for the use of pass students of the Calcutta University have, after some considerable trial of their merits, been put together in the present form so as to embrace all the parts of the subjects which are generally treated of in text-books.

Mr. Willson is an ardent admirer of the works by Professors Thomson and Tait ("the magnificent treatise on Natural Philosophy," "the reader who wishes for further information on this subject (and on all such subjects) is recommended to consult," &c.), and his principal aim has been, we expect, to render the views of these distinguished writers more accessible to junior students. Knowing how liable authors are to go to pieces on the kinematic rocks, we have gone as carefully as we could through the text, and it appears to us that the author not only understands his subject, but has manifested ability in presenting his material in a clear form to his readers. Dynamics he subdivides into statics and kinetics. In both these branches he adopts for unit of force the kinetic unit for which the pound avordupois is the unit of mass. We may remark in passing, that this is the only elementary book we know which goes fully and carefully into the subjects of the several units. Under the head of statics, the writer treats of force at a point, of parallel forces, of moments, of centre of gravity, resisting forces, machines, and of work and energy; under the head of kinematics, we have velocity, accelerated velocity, and kinematical principles and methods; under kinetics, we have dynamical laws and principles, the force of gravity (falling bodies, motion on an inclined plane, Attwood's machine, &c.), collision of bodies, and energy. On p. 130, the term *Roman* steelyard is derived from Rumán, an Arabic word for a pomegranate, "and the shape of the counterpoise seems to have given rise to the name." There are a great many examples, many very familiar to us, given at the end of the various chapters. The author apologises for imperfections in type and diagrams, but he need hardly have done so; we have seen worse diagrams in text-books got out nearer home. Some typographical blunders we have detected, but the context will enable a reader to correct them. The work has no index, is of a handy size, and gives one a favourable impression of the sort of training provided for the Calcutta students.

Mr. Goodeve's name is sufficient warrant for the accuracy and thoroughness of any work on mechanics that bears it on its title-page. His style is very lucid, and the accuracy and fulness of his knowledge of his subject enable him to give just sufficient explanation and yet not be too concise. He aims at a different class of students than that we have had to consider in the former part of our notice. These Text-books are designed for the "self-instruction of working men," and the two works by our present author in this series seem to us just fitted for them. In the work before us we are taken over a wide field. In an Introduction of sixty pages we have a miniature treatise, the representation of force, the gravitation measure of force, the laws of motion, and the meaning of the term energy, *inter alia*, are discussed. In the remaining twelve chapters most of the ground gone over in the first-noticed work is gone over rapidly here, and copious application of the principles is furnished by the description of a number of machines, the bare enumeration of the names of which would furnish an ordinary "Bookshelf" notice; in addition we have an account of the equilibrium and pressure of fluids and of gases, of the hydraulic press and hydraulic cranes, a chapter on girder beams and bridges, the strength of tubes and the catenary, all treated without reference (except in one or two places) to the calculus. We have much pleasure in commending this recent addition to the series, with its clear type and numerous and excellent diagrams, to all who take an interest in mechanical applications. There are many excellent exercises scattered throughout the work.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Degeneracy of Man

IN NATURE, vol. x. p. 147, Mr. Edward B. Tylor writes:—

"It would be well worth while if Dr. Peschel, from personal or published sources available to him, would settle once for all the question whether the great Bavarian ethnologist (Martius) continued through life the degenerationist that we in England suppose him to have been."

Now I can assure Mr. Tylor, from having often conversed with Dr. Martius on Brazilian topics, that his degeneration theory belonged to his earlier life, that afterwards he altered his opinions, and that the passage quoted by Mr. Tylor from Martius contained his latest conviction. Soon after the publication of his Ethnography he died at Munich.

OSCAR PESCHEL

DR. MARTIUS found the rude natives of Brazil treating the hunting-ground of each tribe as common to all the tribesmen, but allowing each family to hold as its own freehold the ground which it had built huts on, or brought under tillage. It is not surprising that this ethnologist, comparing such a rudimentary form of the "village community" with its more artificial arrangements in ancient Europe, should have considered the Brazilian tribes to have arrived at an intermediate stage of the development of land-laws, above that of the lowest savages, and on the way to that of more civilised nations. Mr. Edkins, however, in his letter to NATURE, vol. x. p. 163, thinks that Dr. Martius should not have explained the origin of the Brazilian land-law in this obvious way. The suggestion which he offers in its place is, that inasmuch as the Chinese had in old times a highly artificial system of partitioning their village-lands among the heads of families, some of these Chinese are to be supposed to have emigrated to the Brazilian forests and introduced this system, which in course of ages decayed till nothing was left but the simple rule found by Dr. Martius. But is not the word "far-fetched" applicable to this argument? Sooner than allow the rude people of Brazil to have been human beings capable of adopting the simplest social regulation for their own evident benefit, Mr. Edkins sends half-way round the world for imaginary Chinese emigrants, to introduce, not the savage law itself, but a civilised law which, if broken down to its last remnant, might be reduced to the Brazilian level. And, one may go on to ask, where is it likely that the Chinese themselves got their law of village-lands, if it was not developed out of lower stages of the law of property, belonging to lower stages of civilisation? If Mr. Edkins would turn his great knowledge of Chinese matters to investigating the origin of Chinese institutions, I think he would contribute new evidence to the development-theory of culture. Mr. Edkins next brings forward the evidence of numerals in Polynesia as proof of degeneracy in civilisation. The fact that the word *mano* means 10,000 in the Tonga Islands, 4,000 in the Sandwich Islands, and 1,000 in New Zealand, he accounts for on the supposition that the highest number was the original meaning, but that it was lowered with a fall in civilisation. But he will, I think, on further examination be satisfied that the real reason has nothing to do with degeneration, but with the curious Polynesian habit of counting by twos, fours, and even tens. Thus *rau* and *mano*, which in New Zealand mean 100 and 1,000, come to mean in Hawaii so many fours, viz. 400 and 4,000; Mr. Edkins' own example from Ponape shows the same done with tens (see Hale's "Ethnography of Wilkes' Expedition"). Mr. Edkins also remarks that "the Polynesians formerly had a decimal arithmetic; now it has sunk in Australia to quaternary or quinary arithmetic." But the Australians are not of the same race as the Polynesians, nor is there the least reason to suppose that they were ever at a Polynesian level of culture. As the evidence of numerals has been introduced, it may be mentioned that both Australians and Polynesians use numerals derived from counting on the fingers. Thus the Polynesian *lima*, *i.e.* "hand," is the ordinary numeral for five, while the West Australian will say "the hand on either side and half the feet," meaning by this long expression the number 15 (see my "Primitive Culture," chap. 7). I may add that I have been trying for years to get any degenerationist to answer the argument from numerals of this very common class, which can only have arisen by development from the lower stage of counting on the fingers, and which therefore prove savage tribes to be capable of independent intellectual development.

The *Quarterly Review* argument from the recent discoveries of Dr. Schliemann in the ruins he considers to be of Troy, merely shows that low barbarians may build on the ruins of towns previously inhabited by more civilised nations. This often happens, and can hardly be held to prove that the higher civilisation existed in the world before the lower.

As to the observations (vol. x. p. 163) of Mr. Hyde Clarke on affinities which he believes to exist between languages of Brazil and of the Old World, I cannot make any answer, not having seen any comparative vocabularies on which such an opinion could be founded.

EDWARD B. TYLOR

Photographic Irradiation

FOR the purpose of determining whether any sensible amount of the photographic irradiation surrounding the image of a bright object could be traced to an action taking place within the thickness of the collodion film, I some time ago tried an experiment in many respects similar to that detailed by Mr. Aitken in your last number (vol. x. p. 185). A piece of cardboard with four parallel narrow openings, each some 12 in. long, was hung against the glass roof of a photographic studio so as to be projected against the background of a bright sky. One of the slits or openings was covered with a piece of red glass, another was glazed with blue glass, the third was left entirely uncovered, and the fourth was covered by a piece of thin tracing paper. The slits in the cardboard screen were carefully focused, and over-exposed photographs were taken with a camera in which no stops were used. Upon the collodion film and immediately in contact with it was laid a piece of platinum foil quite thick enough to be perfectly opaque. The camera was so placed that the images of the slits fell partly upon the platinum foil and partly upon the collodion film. I have now before me two of the plates, each taken with an exposure of five minutes. The first was coated in the ordinary manner with a single collodion film, but the other was coated three times successively with collodion, so that the film was rendered very thick; but the eating in or encroachment of the photographic images of the slits under the platinum foil is hardly perceptible in either plate; indeed, I feel that I cannot say with certainty whether there is any encroachment of the image proper, though there are very marked brush-like extensions from the ends of the images, as well as a cloudy semi-circular field symmetrical with the end of each image, evidently arising from reflections from the back of the plate. At first sight the brush-like semi-opaque extensions might be taken for the ordinary photographic irradiation eating under the platinum foil; but on more closely examining the ends of the images, the hazy opacity is seen to extend farther in some directions than in others, and to be broken up in some cases into five or six little streams or brushes. The decrease in the opacity of the brushes is also less uniform than the decrease in the opacity of the ordinary irradiation border. The brushes extend to a distance of about ·02 in. under the edge of the platinum foil.

I do not at present see my way to devise an experiment which would determine what is the cause of these little brushes, nor have I at present had an opportunity of repeating a similar experiment with the dry-plate process; but the brushes have the appearance to me of having been produced by streams in the delicate film of liquid which must extend under the platinum, streams which probably carry with them little masses of light-altered silver, that are soon deposited or strained out in the spongy tissue of the collodion.

If the spreading action under the platinum foil were caused by light dispersed within the thickness of the collodion, one would expect such action to take place symmetrically around the place where the bright image is cut off instead of being broken up, as I have described, into bundles or brushes. On the other hand, slight differences in the texture of the collodion, or minute inequalities on the edge of the platinum foil, might cause the streams in the liquid film to move more easily at one point than at another.

I should be glad to be informed what was the distance of the opaque bar from the collodion plate in Mr. Aitken's experiments, and whether there is not any photographic trace of defraction bands, owing to the bar not having been in focus; possibly the presence of these may account for the apparent difference in our results. It will be seen that the experiment which I have described points to the same conclusion as that formerly announced by Lord Lindsay and myself, viz. that the inner photographic diffraction edge is chiefly due to the imperfection of the instrument producing the image, chief among which is to be counted the aberration of oblique pencils.

A. COWPER RANYARD

MR. AITKEN'S observations on photographic irradiation in NATURE, vol. x. p. 185, are confirmed by many experiments I have made. I spent a long time in efforts to get rid of irradiation in bromide of silver films, one of the results of which I stated in a former note to NATURE (vol. x. p. 63). There is the most striking difference in the behaviour of films containing iodide of silver only to those containing the bromide alone, the latter, especially when dry, giving much greater irradiation; and the difference is again complicated by the addition of certain substances (notably albumen) to the film in the course of preparation. As my experiments were mainly with dry plates, I will leave out of question the forms which the phenomenon may assume in wet-plate photography, and summarise the results of hundreds of experiments with dry plates iodised, bromo-iodised, and bromised.

With a simply bromised film the amount of irradiation is extreme. The film is very translucent and the irradiation is of two kinds, that caused by reflection from the back of the plate being by far the most extensive, but remediable by the usual expedient of coating the back of the plate with red or black colour, while the form noticed by Mr. Aitken is perhaps partially inherent in bromised films, but to a much greater degree dependent on the nature of the pyroxyline. Two samples of pyroxyline made at different temperatures, and treated in precisely the same manner, differ so much, that while one will, with the coloured backing, give scarcely a perceptible degree of irradiation, the other will develop it to an extent which no backing, nor even tinting the film with the aniline reds, will obviate. The former is generally a compact, lustrous film, scarcely to be distinguished from the glass itself, while the other (both being used without preservative solution) will give a dull and dusty-looking surface, only capable of reflecting at very small angles. If with the latter a strip of blackened wood be laid on the film so as to cut across the lightest portions of the image thrown on it by the lens, the effect of the light will be found to spread behind the strip of wood, sometimes to the extent of a centimetre; but I have never noticed the sharp limitation of this form of irradiation which Mr. Aitken observes, and which probably depends on the wet state of the film. It is clearly, as he supposes, an agitation which is set up in the film, and which depends for its propagation amongst the surrounding molecules upon a kind of chemical transparency in the film holding the bromide of silver. That this is to a great extent true is shown by two experiments: (1) a film which, in its simple state, gives considerable halation, will, when coated with albumen, especially if coagulated with nitrate of silver, give none at all, or very little, though the ocular transparency is rather increased than diminished by the albumen; (2) an emulsion prepared by exposing it to the action of nitrate of silver until it becomes structurally decomposed, and highly charged with bromide of silver, shows absolutely no irradiation under any circumstances even if the glass be not backed, and no kind of preservative used. The film in this case resembles unbaked porcelain in its whiteness, entire want of lustre, and in opacity, and the molecules of bromide of silver are more than usually free from any restraining influence which a preservative might be expected, reasoning from the usual action of the albumen, to exert. In these two cases of extreme translucency and opacity of the film there is almost an equal freedom from the phenomenon in question.

In the old albumen process with translucent films the irradiation is imperceptible, and in the collodio-albumen, where the film of albumen is allowed to remain on the collodion, it is almost so; but in this case, as in all cases where the film is charged only with iodide of silver, there is another element which complicates the action. The bromide of silver is reduced *in situ* while the iodide requires a supply of silver from the developer from which to build up the image, in the one case the deposition being by reduction, in the other by accumulation. This alone would account for a wide difference in respect to irradiation, but will not account for all, as is proven by the diverse results obtained from different bromide films, due to the varying structure of the material which holds the bromide in place.

What Mr. Aitken calls "molecular irradiation" (and which is not by any means the harmless thing he considers it in regard to artistic photography any more than to scientific) is unquestionably the great enemy of all photographic precision. It seems, however, to be complicated with what I have been obliged to call structural irradiation, alluded to above, and depending, as I have said, on the mechanical rather than the chemical condition of the pyroxyline of which the bulk of the film consists. The subject yet demands much investigation, of a purely empirical character, in order to determine the quality of vehicle for carrying the sensitive salts, neither chemical analysis nor chemical analogy affording any indication of the true cause of the difference between the two qualities of pyroxylene I have noted, nor do they, so far as I am aware, account for the difference between the action of collodion and albumen.

W. J. STILLMAN

Altenburgh Gardens,
Clapham Common, S.W., July 13

OBSERVATORIES IN THE UNITED STATES*

II.

LIEUT. M. F. MAURY was placed in charge of the new U.S. Naval Observatory, and entered on his duties with zealous purposes. He proposed in 1846 the immense astronomical work of a more extensive and precise cataloguing of the stars than Bessel's "Zone Observations" or Struve's "Dorpat Catalogue." Valuable results of the scheme, so far as it could be entered on, by the observations of Profs. Coffin, Walker, Yarnall, Hubbard, Keith, Major, and Ferguson, and Lieutenants Almy, Maynard, Muse, and others, have been lately reduced and published.

Two events marked this early part of the history with still more importance. Walker, in 1846, proved that the new planet Neptune, just then discovered by Leverrier, had been catalogued as a star by Lalande in his "Histoire celeste" in 1793; and Walker, with Lieutenants Almy and Gilliss, was the very first to use, in 1846, the new discovery of the telegraph to determine differences of longitude. The identification of Neptune with Lalande's star gave astronomers, in determining the new planet's orbit, the use of observations made fifty-two years before. It gave the *American Nautical Almanac* two years earlier ephemerides for the mariner. It brought the observatory into prominence. The superintendency of Maury extended from 1845 to April 26, 1861, when he suddenly left the city to join the cause of the South.

In 1861 Lieut. J. M. Gilliss was at length placed in charge. He re-established and vigorously pressed forward astronomical work as well as the duties of the "Hydrographical Office," a title which had been added to that of the Naval Observatory. After his very sudden death, his successor, Rear-Admiral C. H. Davis, carried forward the astronomical work with that eminent success which had been guaranteed by his previous astronomical tastes and occupancy on the Coast Survey and as superintendent of the *Nautical Almanac*. Rear-Admiral B. F. Sands, succeeding him in the year 1867, has most efficiently improved the opportunities of a longer superintendency to inaugurate and carry forward some of the most important astronomical operations of the day. The phenomena of the total eclipses of 1869 in the United States and of 1870 in the Mediterranean countries were closely observed.

Beyond the regular and severely exacting astronomical routine of observations, two centres of interest have been recently occupying the utmost activities of the institution; the reception, mounting, and use of the new great equatorial, and preparations for the transit of Venus.

The great equatorial has but one near approach to itself in the diameter of its object-glass—that of the private establishment of Mr. R. S. Newall, at Gateshead-on-Tyne, whose telescope has an object-glass of 25 in. in diameter. The Naval Observatory glass has 26 in. clear aperture. It is not easy to realise what this power is, and what it promises. The reader must imagine himself within a dome, itself 41 ft. in diameter and 40 ft. in height, looking through a tube made of three sections of steel stretching away for 32 ft.; the whole telescope and its metallic base weighing about 6 tons.

In the dome, on a pier of mason-work, supported by a pedestal, which is one block weighing $7\frac{1}{2}$ tons, stands the fine equatorial made by Merz and Mahler, Munich, at a cost of 6,000 dols., its object-glass being valued at more than half that sum. The work of this instrument under, successively, Profs. Ferguson, Walker, Hubbard, and Hall, has been chiefly upon the smaller planets, the asteroids, and comets. Mr. James Ferguson was the first American to discover an asteroid, Euphrosyne, in 1854, the thirty-first on a list which has been recently enlarged beyond even a hundred by Peters of Clinton and Watson of Ann

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* Continued from p. 189.

Arbor. The object-glass of the equatorial has an aperture of 9·62 in and a focal length of 14 ft. 4·5 in. Its powers of positive eye-pieces for use with its filar micrometer vary from 90 to 899.

Descending from the dome, and passing the superintendent's office, in which are a most excellent mean-time clock, with others, in the electric circuit with the clocks at the departments, ticking each, beat for beat, the visitor finds himself in the library, now embracing nearly 6,000 volumes. These are mostly works of the highest standard value, astronomical and meteorological observations and discussions, some being as old as the year 1482, others representing the full work of the European observatories and learned Societies to the present date.

From the library we pass into the transit-circle room, built in 1869, to admire the beautiful instrument, with its collimators and its chronograph. The focal length of the object-glass is 12 ft. 1 in.; its clear aperture 8·52 in.; and the power of its eye-pieces 135 to 396. The diameter of its circles at the outer edge is 45·30 in., and at the graduation 43·40 in., both circles being divided to every two minutes. The power of the reading microscopes is 45·3 diameters. Its collimators have a focal length of 2 ft. 11 in. This instrument, under Profs. Newcomb, Harkness, and Eastman, and their assistants, has had for its chief work the more accurate determination of the stars whose places are computed in the *Nautical Almanac*, and of those needed by the Coast Survey. The chronograph, made by Alvan Clark, is of the form known as the Hipp chronograph, with modifications by Prof. Harkness.

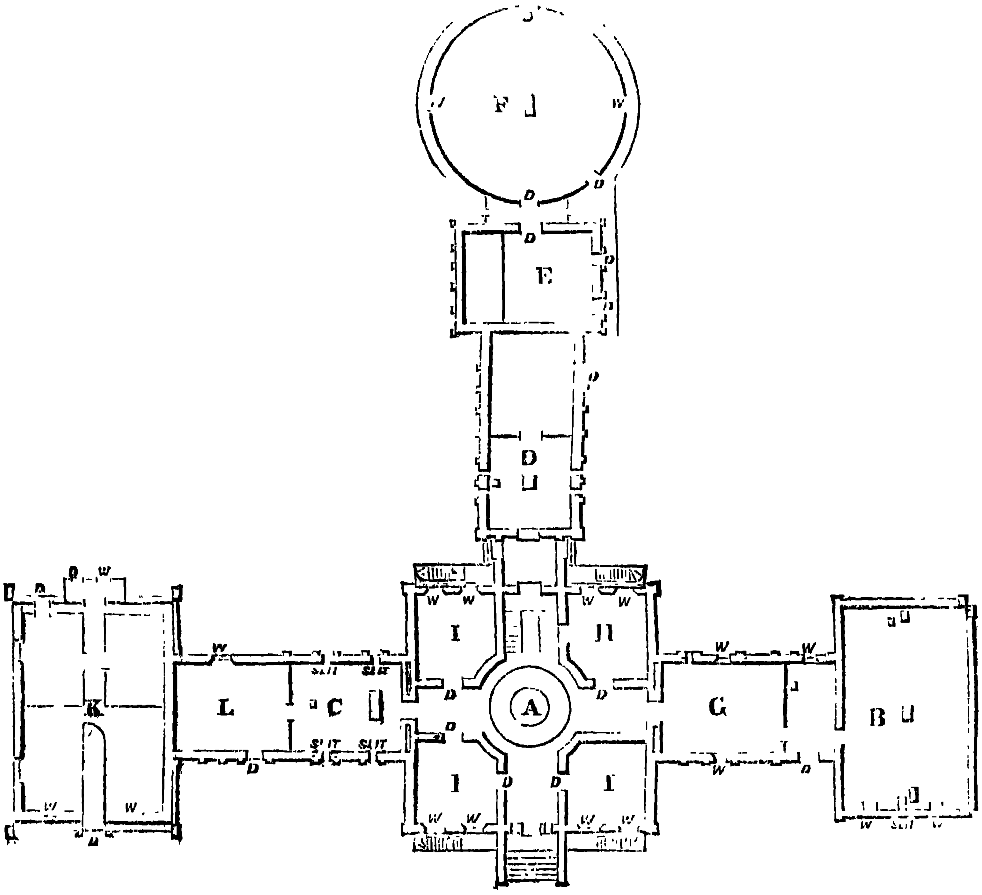


FIG. 6—The United States Naval Observatory—Ground Plan. A, Pier of Equatorial B, Transit Circle. C, Mural Circle and Transit. D, Prime Vertical. E, Computer's Room for Great Equatorial F, Great Equatorial. G, Library. H, Superintendent's Office. I, I, I, Offices. K, Superintendent's Dwelling. L, Chronometer-Room. D, Door. W, Window.

Passing to the eastern wing there are seen, side by side, the mural circle and the smaller transit instrument, with their clock and chronograph. The mural circle has an object-glass of 4·10 in., and a focal length of 5 ft. 3·8 in., the highest power of the eye-pieces being 240. The diameter of the circle at its outer edge, where the graduation is placed, is 60·35 in. It is divided to every five minutes; the power of its reading microscope is 17·1 diameters. The transit has a focal length of 7 ft. 0·4 in., and its object-glass an aperture of 5·33 in.

The chronometer-room shows another and a distinct but important office of the observatory. The relation of all its work to the interests of practical navigation is sufficiently clear. More than 200 time-keepers have been at one time under care in this room. As many as eighty in 1867 were condemned and withdrawn from use. It is as gratifying as it is creditable to American skill to find that the chronometers of Messrs. Negus and Co., of New York, equal, if they do not excel, any of foreign workmanship.

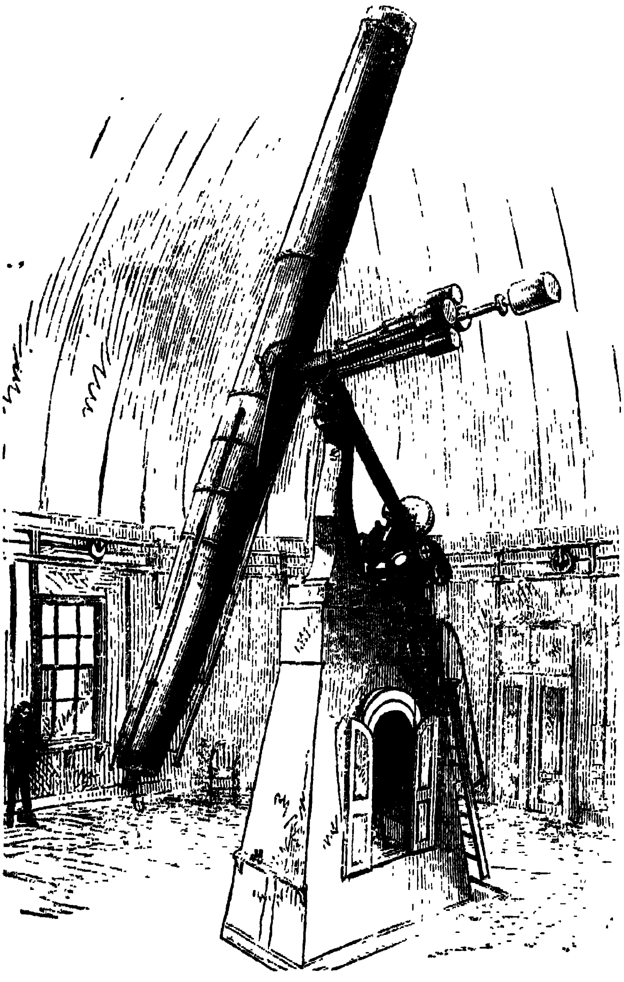
From this room of the observatory the exact time is furnished daily at 12 M. to the Western Union Telegraph Office in Washington for dispatch throughout the United States. The naval officer, standing by the standard mean clock, and having the astronomical correction of that clock also before him, at three minutes before 12 M. calls the telegraph operator at his office, and, at the instant of noon, taps the electric key, giving the time to the company's office. He also drops the dome ball. The chronometer-room is under the very efficient direction of Commander A. W. Johnson, U.S.N.

The seventeen annual volumes of astronomical and meteorological observations now published best set forth in themselves the work of the observatory. The latest of these volumes vie in extent and in value with the publications of Greenwich and Paris. The star catalogue, issued as Appendix No. 1 to the volume for 1871, embraces more than 100,000 observations, giving the places of 10,000 stars. It is the twenty years' work of Prof. M. Yarnall, embracing the reduction of his own observations and those of others from the year 1845 to 1871. The astronomer knows how to appreciate such a work.

Congress, in whose hands is the destiny of the institution, has promptly appreciated its claims, and does not withhold the liberal appropriations asked for it as due to astronomy and to this branch of naval efficiency.

West Point Observatory.—This observatory was erected in 1839 for astronomical purposes and the accommodation of the library of the Academy and its philosophical apparatus. The institution of an observatory is to be credited to Prof. W. H. C. Bartlett, LL.D., so well known for more than thirty years as its director. In 1840 Prof. Bartlett visited Europe for the United States Government, inspected and reported upon its chief observatories, submitting also a plan for an observatory at Washington, and purchasing for West Point whilst abroad its three large instruments, the equatorial, the transit, and the mural circle.

The transit instrument in the east tower was made yb Ertel and Son, and its object-glass by Merz and Mähler, at Munich, the whole cost being about 1,130 dols. It was mounted in 1843, the memorable year for observatories in the United States. Its object-glass has a clear aperture of 4·62 in., and a focal length of 76·75 in. It is provided with four eye-pieces and one dark glass, and has an illuminating apparatus, giving either a bright field with dark lines, or a dark field with bright lines, which can be modified at will by means of a coloured wedge. The reticule has seven vertical and two horizontal lines. An extra vertical wire is driven in a horizontal direction by means of a micrometer screw, each division of which corresponds to 0″·334. It has a striding level, each small division being 1″·23 = 0·082s. The steel pivots have not sensibly changed their equality of dimensions since the instrument was mounted.



G 7.—The Great Equatorial—United States Naval Observatory.

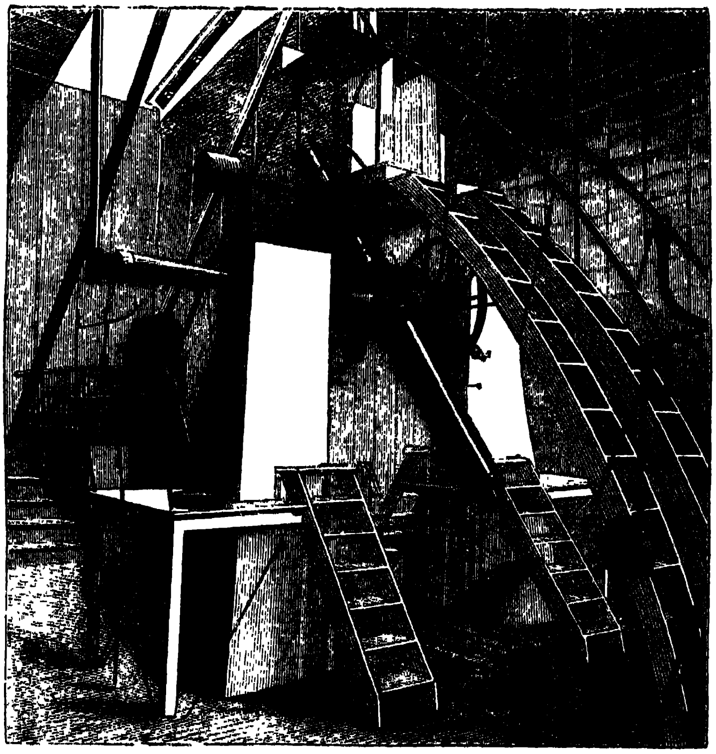


FIG. 8.—Transit Circle—United States Naval Observatory.

The west tower has the mural circle, by Troughton and Simms, of London. This was cast in one entire piece of brass. Its diameter is 5 ft., and its graduations are on two bands, one of gold, the other of palladium. The telescope has a clear aperture of 4 in., with a focal length of 60 in.

The central main tower has a revolving dome of 27 ft. in diameter, which rests on six 24-pound cannon-balls, turning between cast-iron annular grooves. The equatorial, made by Mr. Henry Fitz, of New York, has a focal length of 14 ft., and a clear aperture of 9¾ in. It has thirteen eye-pieces. The hour circle reads to two seconds of time, and the declination circle to twenty seconds of an arc, each circle being 20 in. in diameter. This instrument cost 5,000 dols.

The sidereal clock, by Hardy, has a Bond break-circuit attachment, and is connected with the several instruments by wires and break-circuit keys. Besides these there are valuable portable instruments in the observatory, which lends them from time to time to topographical and surveying parties in the west and north-west, or to stations of the Engineer Corps, like the one at Willett's Point, New York. Several valuable additions, including a Bond chronograph, the odolites, and sextants, have been made within the last two years.

The purposes of the observatory of the Academy are most effectively secured by confining its workings to the end of educating the cadets in the knowledge and practical use of the instruments. During the spring months they are taken in parties of two, three, or four to receive such instruction, and are required themselves to make observations with each instrument, and reduce them. During the summer encampment a month is devoted to further instruction in connection with a field observatory at Fort Clinton, where they use a field transit, zenith telescope, and other instruments. Each makes his own records, and works out his results for the ordinary problems of time, latitude, longitude. Würdeman of Washington is constructing for this field observatory a new transit and zenith telescope.

Although the chief design of the observatory has been from the first to secure such proficiency in the cadets as would prove of most value to them in the field work to which so many army officers are called, and although neither the professors nor their assistants, who are daily instructors in several other branches, can find time available for lengthened series of observations, still at different times valuable observations have been secured in the midst of pressing duties. Among these are those of Prof. Bartlett on the great comet of 1843, published in the Transactions of the American Philosophical Society, and recent observations under Prof. Michie and his assistants, Lieut. Bass and others, for determining the longitude of the observatory.

Annapolis Observatory.—We cannot complete this sketch of the United States Government observatories without a just, though necessarily very brief, notice of the observatory used in the instruction of midshipmen at Annapolis.

The Department of Astronomy was created in 1853, and until 1865 was in charge successively of Profs. Chauvenet and Coffin. Since that time a graduate of the Academy has from time to time been in charge. The course in astronomy is of necessity limited, most of the midshipman's time in this department being required for the study of practical navigation. We learn from the report of Lieutenant-Commander R. L. Phythian to Admiral Porter in 1869 the following facts:—"The instruments used in this department are the chronometer, the sextant, the artificial horizon, the azimuth compass, the surveyor's chain and compass, the theodolite, and the plane-table. The observatory is supplied with a sidereal clock, an equatorially-mounted telescope, and a superior meridian clock. These instruments are used in instruction only to show the midshipmen the principles of them. There is not sufficient time for them to acquire a practical knowledge of their use by observing with them."

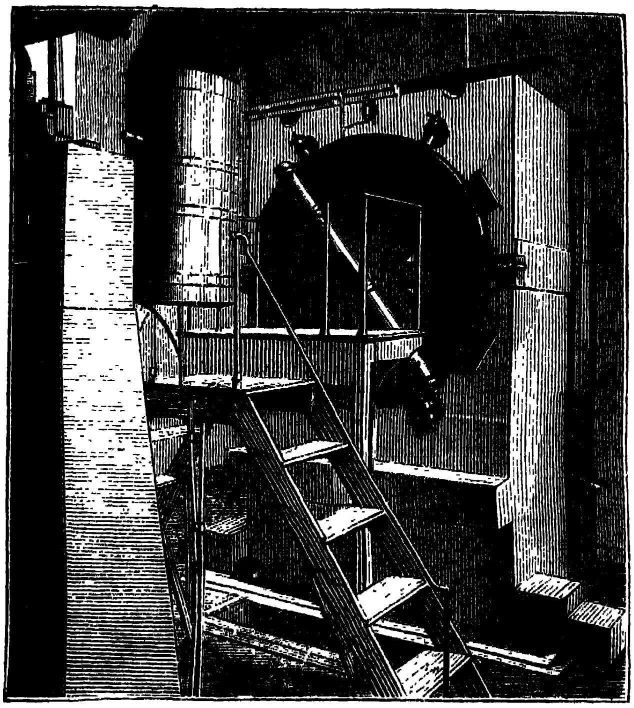


FIG. 9.—Mural Circle and Smaller Transit Instrument—United States Naval Observatory.

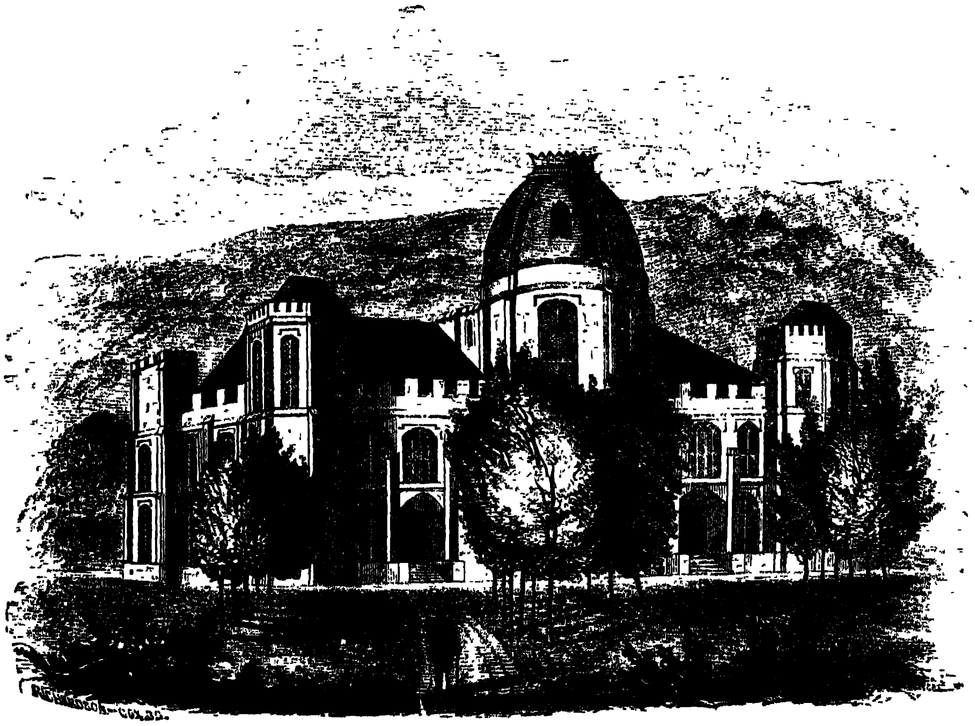


FIG. 10.—West Point Observatory—North Front.

Altogether the United States has reason to be proud of her observatories, and of the work already done by her astronomers.

THE RELATIONS BETWEEN HUMAN MORTALITY AND THE SEASONS OF THE YEAR

AT the anniversary meeting of the Scottish Meteorological Society, a very valuable paper was read by Dr. Arthur Mitchell, and the Secretary, Mr. Alex. Buchan, giving an account of their investigations on the subject of the influence of the seasons on human mortality at different ages as caused by different diseases. The authors have calculated the weekly average death-rate of London for the past thirty years for thirty-one diseases, together with the averages of temperature, moisture, rain, &c. Considering the weather experienced in the course of the year as made up of several distinct climates differing from each other according to the prevailing temperature and moisture and their relations to each other, the influence of these climates, characterised respectively by cold, cold and dryness, dryness and heat, heat, heat and moisture, and cold and moisture, on the mortality was pointed out. The weekly mortality from all causes and at all ages shows a large excess above the average from the middle of November to the middle of April, from which it falls to the minimum in the end of May; it then slowly rises, and on the third week of July shoots suddenly up almost to the maximum of the year, at which it remains till the second week of August, and thence falls as rapidly as it rose to a secondary minimum in October. Regarding the summer excess in the death-rate, which is so abrupt in its rise and fall, it was shown that it is wholly due to one section of the population, viz. infants under five years of age, none of the curves for the other ages showing an excess in the death-rate from all causes during the summer months; and it was further shown that the summer excess is due not only to the deaths at one age, but to the deaths from one class of diseases, viz. bowel complaints. The importance of weekly averages in discussing these sudden fluctuations of the death-rate to the changes of the weather was pointedly referred to. Deducting the deaths from bowel complaints from the deaths from all causes, the curve assumes a simple form, viz. an excess in the cold months and a deficiency in the warm months. In other words, the curve of mortality is dictated by the large number of deaths from diseases of the respiratory organs. The curve of mortality in London has thus an inverse relation to the temperature, rising as the temperature falls, and falling as the temperature rises. On the other hand, in Victoria, Australia, the curves of mortality and temperature are directly related to each other—mortality and temperature rising and falling together. The character of the curve of mortality in Victoria is impressed on it by the deaths of persons below the age of five; and among such young persons the special diseases which determine this influence are diarrhœa and dysentery. This peculiarity arises from its higher mean temperature, 57°·6, as compared with that of London, 50°·0. In London also during the hottest months of the year the curves of mortality and temperature rise and fall together, whereas in Victoria the curves are throughout the whole year directly related; for though doubtless the deaths from diseases of the respiratory organs fall as the temperature rises, and rise as the temperature falls, yet the number of deaths from these diseases is, owing to the comparatively high winter temperature, never sufficiently large to influence the curve of the whole death-rate. The curves of mortality for bronchitis and pneumonia at different ages prove that the fluctuation is much less for pneumonia than for bronchitis, and that the excess in both cases of infant mortality is great, but not nearly so great as the infant mortality for diarrhœa. The curves show that the maximum mortality from the different diseases group around certain specific conditions of temperature and moisture combined, the general result of which, as regards the principal diseases, may be thus roughly stated:—

Character of Weather	Maximum Mortality
Cold	Bronchitis, pneumonia, asthma, &c.
Cold and dry	Brain-disease, convulsions, whooping-cough
Warm and dry	Suicides, small-pox
Warm and moist	Diarrhœa, dysentery, cholera
Cold and moist	Rheumatism, heart-disease, diphtheria, scarlatina, measles, croup

The deaths from cancer and liver disease show no distinct relation to weather. The period of the year least marked by the occurrence of maximum mortality from any disease is the warm dry weather which prevails from the middle of May to the end of June. At this season the only maximum is a well-pronounced secondary maximum for measles; and the maxima for suicides and small-pox, which are, however, extended from the middle of April into these months. Convulsions, teething, and atrophy and debility have a secondary maximum in the warm moist weather of July and August. In the United States, where the heat is greater in summer, the secondary maximum for convulsions is more distinctly marked than that of London; and in Victoria the summer maximum is the only one that appears. The contrast offered by certain curves to each other in all points is very striking. Thus the curve for whooping-cough begins to rise above its average in the middle of December, attains its maximum in March and April, and falls to the minimum in September and October, whilst the curve for scarlatina is exactly the reverse of all this, having its minimum in spring and its maximum in autumn. It was inferred from the general teaching of the curves, that if a curve representing the progress of the death-rate from a particular disease were given for a place whose climate was known, though it might be impossible to name the exact disease, it would be possible to say with a considerable degree of certainty whether, for instance, the nervous system, or the respiratory organs, or the abdominal organs were involved in the disorder which caused the deaths.

CONFERENCE ON THE REGISTRATION OF PERIODICAL NATURAL PHENOMENA

THE Council of the Meteorological Society recently resolved to organise a system of Observations of Natural Phenomena, connected with the return of the seasons, as well as of such branches of physical inquiry as tend to establish a connection between meteorological agencies and the development of vegetable life.

As a preliminary to carrying out this intention they invited the various Societies before which such subjects most naturally come to nominate delegates to join a committee by whom the whole question as bearing upon agriculture, horticulture, &c., should be considered, and to whom also any written communications should be submitted.

The first meeting of this joint committee was held at the Office of the Meteorological Society, 30, Great George Street, on Thursday, July 2, when delegates were present and promises of co-operation read from the Royal Horticultural, Royal Agricultural, Royal Botanical, and other Societies. After the subject had been fully discussed the Rev. T. A. Preston, of Marlborough College, was requested to prepare a list of plants to be observed, and also to draw up a report on the same. Other gentlemen were requested to prepare lists of insects, birds, and animals.

THE SPECTRUM OF THE AURORA BOREALIS*

THE author's object in this paper is to make a small contribution towards the solution of the question, how the composition of the spectrum may be most correctly explained?

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* By the late Prof. A. J. Angström.

It may be assumed that the spectrum of the aurora is composed of *two* different spectra, which, even although appearing sometimes simultaneously, have in all probability different origins.

The one spectrum consists of the homogeneous yellow light which is so characteristic of the aurora, and which is found even in its weakest manifestations. The other spectrum consists of extremely feeble bands of light, which only in the stronger auroræ attain such an intensity as enables one to fix their position, though only approximatively.

As to the yellow lines in the aurora or the one-coloured spectrum, we are as little able now as when it was first observed to point out a corresponding line in any known spectrum. True Piazzi Smyth (*Comptes Rendus*, lxxiv. 597) has asserted that it corresponds to one of the bands in the spectrum of hydrocarbons; but a more exact observation shows that the line falls into a group of shaded bands which belong to the spectrum, but almost midway between the second and third Herr Vogel has observed that this line corresponds to a band in the spectrum of rarefied air (Pogg. Ann. cxlvi., 582). This is quite right, but in Angström's opinion is found on a pure misconception. The spectrum of rarefied air has in the green-yellow part seven bands of nearly equal strength; and that the auroral line corresponds with the margin of one of these bands, which is not even the strongest, cannot be anything else than merely accidental. Observations on the spectrum have not hitherto agreed with each other; partly, perhaps, because of the weak light of the object, but partly also, it may be, on account of the variability of the aurora. The red does not always appear, and when it does is often so weak that it cannot be observed in the spectroscope. If now it be assumed that the aurora has its final cause in electrical discharges in the upper strata of the atmosphere, and that these discharges, whether disruptional or continuous, take place sometimes on the outer boundary of the atmosphere, and sometimes near to the surface of the earth, this variability will easily show in the appearance of the spectrum what the observations appear to confirm.

If we consider the conditions under which the electric light appears on the boundary of the atmosphere, moisture in that region must be set down as nil, and consequently the oxygen and hydrogen there must alone act as conductors of electricity. Angström has tried to reproduce these conditions on a small scale. Into a flask, the bottom of which is covered with a layer of phosphate, the platinum wires are introduced and the air is pumped out to the extent of several millimetres. If the inductive current of a Ruhmkorff coil be sent through the flask, the whole flask will be filled, as it were, with that violet light which otherwise only proceeds from the negative pole, and from both electrodes a spectrum is obtained consisting chiefly of shaded violet bands.

If this spectrum be compared with that of the aurora, Angström thinks that the agreement between the former and some of the best established bands of the latter is satisfactory.

Lines		Wave-lengths		
Of the aurora spectrum . .	According to Barker .	431	470·5	
	„ „ Vogel .	—	469·4	523·3
	„ „ Angström	—	472	521
	„ „ Lemström	426·2	469·4	523·5
	Mean . . .	428·6	470·3	522·6
Of the spectrum of the violet light . . .		427·2	470·7	522·7

In the neighbourhood of the line 469·4 Herr Vogel has moreover observed two weak light bands, 466·3 and 462·9. The spectrum of the violet light has also two corresponding shaded bands, 465·4 and 460·1.

Should the aurora be flamy and shoot out like rays, there is good reason for assuming a disruptive discharge of electricity, and then there ought to appear the strongest line in the line-spectrum of the air, the green, whose wave-length is 500·3. Precisely this has been actually observed by Vogel, and has moreover been seen by Angström and others.

Finally, should the aurora be observed as it appears at a less height in the atmosphere, then are recognised both the hydrogen lines and also the strongest of the bands of the dark-banded air-spectrum, as *e.g.* 497·3. There are found also again nearly all the lines and light bands of the weak aurora spectrum, whose position has with any certainty been observed.

There still remains the line in the red field, the wave-length of which, according to Vogel, may be valued at 630. Angström has chanced to see it only a single time, while on various occasions, when the aurora has shown red lights, he has found it impossible to distinguish any lines whatever in this part of the spectrum. The cause of this may be that while the red bands in the spectrum of the negative pole are broad and very feeble in light, the corresponding light in the aurora may be imperceptible in the spectroscope on account of the dispersion of the prism, although it is strong enough to give to the aurora a reddish appearance. Angström does not venture to decide whether the red line observed by Vogel coincides with the strongest of these bands, but so much is at least certain, that it may coincide with more than one of the bands to the red field of Plucker's air-spectrum.

In general it may be thus assumed that the feeble bands in the aurora spectrum belong to the spectrum of the negative pole, and that the appearance of this spectrum may be changed more or less by additions from the banded air-spectrum or the line-spectrum of the air.

But by this is not yet explained the one-coloured spectrum or the origin of the yellow line. The only explanation of the origin of this line which in Angström's opinion is in any way probable, is that it owes its origin to *fluorescence* or phosphorescence. Since fluorescence is produced by the ultra-violet rays, *an electric discharge may easily be imagined, which, though in itself of feeble light, may be rich in ultra-violet light, and therefore in a condition to cause a sufficiently strong fluorescence.* It is also known that oxygen is phosphorescent, as also several of its compounds.

There is therefore no need, in order to account for the spectrum of the aurora, to have recourse to the "very great variability of gas spectra according to the varying circumstances of pressure and temperature," a variability which according to Angström's twenty years' observations does not exist. Just as little can Angström admit that the way in which a gas may be brought to glow or burn, can alter the nature of the spectrum; since it is an established fact in physics that the state of light and of heat which puts a body into a glowing condition is unconnected in character with that which produces glowing.

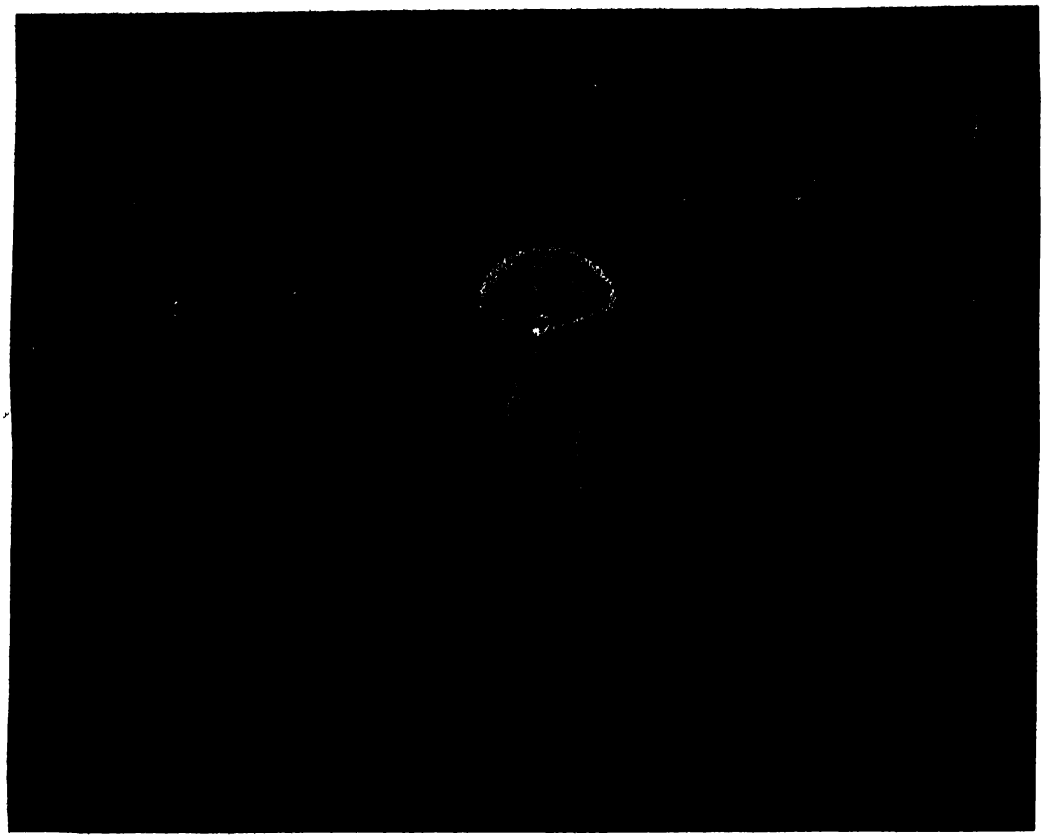
Angström does not entirely deny the possibility that a simple body by glowing in a gaseous condition will offer several spectra. Just as one simple body can form a chemical combination with another, and this body by glowing in a gaseous condition, so long as it is not decomposed, gives its own spectrum, so must it also be able to form combinations with itself—thus to form isomeric combinations—it being always supposed that it exists in the gaseous form and can maintain itself in a glowing condition without decomposition. In this way it is indeed possible to conceive an absorption for oxygen which belongs to ozone; but since ozone, as is well known, cannot maintain itself in a glowing condition, it is in vain to look for more than one spectrum of oxygen. There is, however, at least a possibility of obtaining several spectra from sulphur, while again with respect to carbon, which cannot even be exhibited in a gaseous condition, a like assumption in the author's opinion wants the support of experience.

THE COMET

WE have received from Mr. Lockyer, who has been observing the comet with Mr. Newall's 25-inch refractor, the accompanying rough sketch of its general appearance in that instrument. The drawing he states is only intended to show the features in their most general aspect, in order that the striking differences between the present comet and former ones may be apprehended.

His observations, to which we hope to refer at some length, extended over several hours on Sunday and Tuesday nights, and great changes were observed.

One of the new observations made was that a photographic plate exposed for ten minutes gave no results on the comet, while the dimmest of the seven stars in the Great Bear, inferior to the comet in brightness, recorded itself in two minutes' exposure.



Rough Outline Sketch of Head and Envelopes of Coggia's Comet as seen in Mr. Newall's 25-inch Refractor on the night of July 12.

It is hoped that the observations, made under first-rate atmospheric conditions, with the magnificent instrument with which Mr. Newall has endowed British Astronomy, will throw light upon cometary structure, and help to clear up many anomalies.

JASPER'S "BIRDS OF NORTH AMERICA"*

A SHORT time ago we gave our readers some account of the important work of the "Birds of North America," lately issued by Prof. Baird with the co-operation of some of the principal naturalists of the United States. It has just come to our knowledge that a rival work has been started with nearly the same title, concerning which it may be useful to such of our readers as turn their studies in an ornithological direction that we should say a few words.

Jasper's "Birds of North America" appears to have been started by an enterprising publisher at Columbus, Ohio, "to meet a common want and gratify a universal taste." It is issued in numbers, the first of which bears date Nov. 1, 1873. It is to contain coloured figures and descriptions of over 600 species, and a popular account of their habits and manners—likewise a general outline of the science of ornithology—all from the pen and pencil of Dr. Theodore Jasper, "who has made the study of ornithology the business of his life."

Now we have no desire at all to interfere with Mr. Jacob H. Studer's undertaking. We quite agree with Mr. Studer's notions that a knowledge of American birds is or should be a "common want," and we are also of opinion that a "universal taste" should be gratified if possible. At the same time we must be allowed to say, after examining what has yet appeared of Mr. Jasper's work, that, in our judgment, those who wish to become well acquainted with American ornithology had better consult Prof. Baird's volumes. Mr. Jasper, it is true, furnishes coloured figures of every species or proposes to do so. But these, prepared by chromolithography or some similar process, are not sufficiently carefully coloured for the discrimination of specific differences—at any rate as regards the smaller birds. And in every other particular Baird's "American Birds" is far superior. Mr. Jasper's work can indeed be hardly placed in the same category, the author being obviously acquainted with little more than the results of his own experience, whilst Prof. Baird and his coadjutors are fully up to the level of modern science.

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* "The Birds of North America, drawn from life and uniformly reduced to one-quarter their natural size," by Dr. Theodore Jasper. In 4to. parts. Columbus, Ohio, 1873-74.)

NOTES

THE statue of Dr. Priestley will be unveiled at Birmingham on Saturday, Aug. 1 (the centenary of his discovery of oxygen). Prof. Huxley will make the presentation to the town, on behalf of the subscribers, and will deliver an address in the Town Hall.

WE understand that the recently established Stricklandian Curatorship in the Cambridge University Natural History Museum has been offered to and is likely to be accepted by Mr. Osbert Salvin, F.R.S., one of our most distinguished ornithologists.

LORD LILFORD has just returned from a natural history cruise in the Mediterranean, and amongst the most interesting specimens he has brought home with him is a pair of Audouin's Gulls (*Larus audouini*) from the small island of Toro on the coast of Sardinia, which he has deposited in the gardens of the Zoological Society. The rareness of these birds makes them of peculiar interest.

A LARGE collection of giraffes, antelopes, and other African mammals has lately been imported into Hamburg by Mr. C. Hagenbeck, the well-known dealer in animals of that city, from the Atbara district of Upper Nubia. Three of the finest giraffes have been secured by the Zoological Society, and are daily expected to arrive in London.

A REPORT is said to be current at St. Petersburg that the Austrian Polar Expedition, of which nothing has been heard for a considerable time, and respecting the safety of which apprehension is accordingly entertained, is lying off the coast of Novaya Zemlya.

THE Caen Academy of Science and Art proposes as the subject of the Le Sauvage prize, of the value of 4,000 francs, to be awarded in 1876, the question of the Function of Leaves in the Vegetation of Plants. The Academy does not want simply an exposition of the present state of Science on this important question; it requires, besides, from competitors, exact experiments performed by themselves, and new facts tending to throw light upon, invalidate, confirm, or modify doubtful points in the theories at present accepted. The memoirs ought to be sent to the Academy before Jan. 1, 1876.

A FIFTH "sub-edition" of Dana's "Mineralogy" has been issued, with an appendix, by Prof. Brush.

JOSHUA HOOPES, the last survivor of the old school of the botanists of Chester County, Penn., of which Darlington was the chief, and the "Flora Cestrica" the memorial, died on May 11 at the age of 86.

MR. HERBERT SPENCER has published in a separate form, with some additional correspondence and comments, the correspondence which was carried on in NATURE between himself, the "Quarterly Reviewer," Mr. R. B. Hayward, and others.

M. LEVERRIER has presented to the Council of the Observatory a new set of regulations for the better working of the establishment. In drawing out these regulations the illustrious astronomer took advantage of the visit he recently made to Greenwich Observatory.

MAGNETIC instruments are to be erected on a piece of ground situated between the Boulevard Arago and the Observatory Gardens, Paris. This land belongs to the French Government, which has given it up for the purpose mentioned.

M. FAYE has been nominated President of the Bureau des Longitudes. M. Janssen, who was a member of the Section of Geography, has been appointed by the Minister a member of the Section of Astronomy. There will be an election to fill up the place thus vacated. This is the first time that a member has been transferred from one section to another.

DR. GARRIGOU, of Bagnères de Luchon, has established, at his own expense, a laboratory for analysing the mineral waters of the Pyrenees. The laboratory is open to men of science for their own researches.

THE Worshipful Company of Clothworkers has founded a "Professorship of Textile Industries" in connection with the Yorkshire College of Science, with a stipend of 300*l*. a year and two-thirds of the students' fees. The stipulated qualifications for the post have been just announced. The selected candidate will be required to have a practical knowledge of all materials used in the woollen and worsted manufactures, and the selection of materials for special kinds of goods; to be able to give instruction in every department of weaving, including the practical handling of the loom; plain drawing, and analysis of patterns; to apply the laws of colour to the production of coloured designs, and to finish coloured designs on paper, prefiguring the woven fabric; to make all the calculations required in the manufacture of woollen or worsted goods; to explain and illustrate the processes of carding, combing, and spinning; and to give practical illustrations of scouring, fulling, and finishing. The chemistry of dyeing will be taught by the Professor of Chemistry. It will be a condition of appointment (*inter alia*) that the Professor is to give lectures at stated times upon improved modes of manufacture at other of the chief towns connected with the cloth-working industry both in Yorkshire and the west of England.

THE result of the Sandwell Park trial sinking for coal being that a seam 20 ft. 6 in. has been found at a depth of 418 yards, it is proposed to furnish an account of the fossils met with and the general character of the red rocks passed through. Prof. Ramsay and others have promised their assistance for this work.

URIAH A. BOYDON, of Boston, has deposited with the Franklin Institute the sum of 1,000 dols. to be awarded as a premium to "any resident of North America who shall determine by experiment whether all rays of light, and other physical rays, are or are not transmitted with the same velocity." The memoirs, which are to describe in detail the apparatus, mode of experimenting and results, are to be sent in to the secretary of the Institute by Jan. 1, 1875. The Institute is to appoint three judges, and has reserved to it the power to decide whether or not the recommendation of the judges shall be carried out. Should the judges think proper, they may require the experiments described in any of the memoirs to be repeated in their presence.

THE report of the State Board of Health of Massachusetts, 1874, says that a large part of the 450 analyses there given were performed by a lady in the laboratory of the Massachusetts Institute of Technology.

THE Geological Society of France intends to hold its annual session this year at Mons, immediately on the conclusion of the session of the French Association for the Advancement of Science. The meetings commence on August 30, and will last about a week, during which some interesting excursions have been arranged for.

IN the Engineering Department of King's College the following Physical Science Exhibitions will be given in October next. The Treake Entrance Exhibition of 20*l*., also two Exhibitions of 30*l*. and 21*l*. will be given by competitive examination among the students matriculating in this department at that time, provided a satisfactory degree of proficiency is shown by the candidates. The examination will consist of four papers, two in mathematics, one in elementary mechanics and physics, and one in chemistry, and will take place on Thursday, October 1, and two following days.

THE Provost and Fellows of Worcester College, Oxford, have voted the appropriation of 2 per cent. of their revenues to non-collegiate University uses, and have resolved that this sum for the next five years shall be paid in equal proportions to the Bodleian Library and University Museum.

MR. F. BUTLER, B.A., of Worcester College, who obtained a first class in Natural Science at the recent examination at Oxford, has been appointed Natural Science Master of Reading School, and during the vacation a laboratory will be fitted up at the school under his supervision.

THE large and lucrative industry which has sprung up on the American coasts in the preservation of lobsters in tins, has induced some energetic persons to start a lobster farm near Boston, where an area of about 32 acres has been laid out and protected for the purpose of cultivating the lobster. On the seaward side it is closed by banks, having hatches or sluices so as to admit of the flow and ebb of the tide. Last summer about 40,000 lobsters, of all sizes, were deposited in this ground. The maimed and the halt and the lame and probably the blind are accommodated with quarters where they can recover their lost claws; and a *crèche* for the infantine population is provided, where they can increase without the ordinary dangers attendant on lobsterial infancy. Food, in the shape of refuse fish, &c., is liberally supplied to this interesting community. In the winter the managers evinced the natural deceitfulness of human nature by catching and scalding the lobsters on which so much attention had been lavished, and a fine harvest rewarded them; 15,000 fine lobsters were sold, and the success of the experiment seems complete. Besides lobsters, it is intended that the farm shall be turned to account by being made a nursery for fish of various kinds. As a matter of fact many eels and other fishes were caught in the spring. The venture seems a very successful one; and in view of the enormous drain on the natural lobster grounds of America, it is very necessary that some such steps should be taken, as a supplement to the regulations proposed to prevent overfishing, and fishing in the breeding season.

THE suggestion has been made that kangaroos might be generally cultivated in parks and other enclosures in this country; and it is probable that they would prove quite as useful as deer. A French naturalist, M. Cornély, has recently published some novel information on the subject, which seems to show that the proposal is perfectly feasible in every way. The experience of the various zoological societies in Europe shows that this marsupial will thrive and breed in our climate, damp being the only condition which is fatal to it. It will bear great extremes of heat and cold without injury. M. Cornély says that they are not destructive to trees and shrubs, and that if any individuals contract the habit of barking trees, they can be broken of it by shutting them up for two or three days without food. On being released they are so eager in search of grass that they do not touch the trees. As an ornamental adjunct to an English park, the presence of kangaroos would prove very valuable; their skins are highly prized on account of the quality of the leather, and most probably the principal obstruction to the more general cultivation of the animal is the prejudice that exists against the introduction of novelties.

A SEVERE earthquake is reported to have occurred in Utah at midnight on June 18.

WE learn with great pleasure that during the last three years there has been a very successful class for botany in connection with the Royal Veterinary College. From some notices of excursions made during the present summer which have been sent us, we see the field-class is one of the largest in London, or anywhere else we should think, and that the excursions are made the means of valuable training as well as of conveying solid information.

THE Council of the Institution of Civil Engineers has just awarded the following, among other premiums and prizes:—A Telford Medal and a Telford Premium to Joseph Prestwich, F.R.S., Assoc. Inst. C.E., for his paper On the geological conditions affecting the construction of a tunnel between England and France. A Watt Medal, and a Telford Premium, to Alexander Carnegie Kirk, Assoc. Inst. C.E., for his paper On the mechanical production of Cold. A Telford Premium to Major James Browne, R.E., Assoc. Inst. C.E., for his paper On the tracing and construction of roads in mountainous tropical districts.

THE following is a translation of the telegraphic despatch received in Paris by Gen. Morin from H.M. the Emperor of Brazil:—"Service from Rio de Janeiro to Paris *viâ* Falmouth, June 23, 6 o'clock. Electric telegraph established from Europe to Brazil. In addressing you my congratulations on this victory of science, I beg you to communicate my satisfaction to all your colleagues of the Academy of Sciences, to whom I owe so many marks of good-will. Don Pedro." The Academy immediately replied: – "The Academy, moved by his Majesty's remembrance, offers him its thanks, its respects, and its vows."

WE would strongly urge on our readers' attention the appeal made through the daily papers by Mr. C. R. Markham, F.R.S., on behalf of the Cameron-Livingstone expedition. A letter from Lieut. Cameron, dated Ujiji, Feb. 28, tells of his having secured Dr. Livingstone's map and journal from Mikandany, which he was to send home in a few days. "The fish of Tanganyika," he states, "are more like sea than fresh-water fish. The Tanganyika is a veritable sea. I will send home a bottle of lake-water to be analysed. I cannot understand, receiving as it does rivers that flow through a salt soil, why the waters of the lake should not be salt. I believe that it is gradually being filled up."

THE Report of the Commissioners of Fisheries for the State of New York states that in 1872 upwards of seven and a half millions of young shad were hatched and turned into the river Hudson at the cost of the State; and five millions were added in 1873. In the spring of the latter year, several hundred thousand shad were transported into California and into the great American lakes, where it is hoped they will become fairly acclimatised. The Sacramento River Salmon, and the Whitefish (*Coregonus albus*) have, in return, been introduced from the lakes and rivers of the West to the Eastern States. The enactment of a close time, during which the shad may be allowed to proceed unmolested up stream to spawn, is urgently desired, otherwise the natural increase of the fish can never occur, and the results of the artificial culture and propagation are nullified. The efforts of the Commissioners, who have erected extensive hatching premises at the cost of the State, have resulted in much more light being thrown on the subject of pisciculture. So thoroughly is the process of artificial spawning and fecundation carried out, and so carefully are the after stages of development assisted, that nearly cent. per cent. of the eggs taken are actually hatched. Under ordinary circumstances hardly twenty per cent. of the eggs are hatched. The importance of this system in re-stocking barren or depopulated waters cannot be over-estimated; but its results can never be fully successful until all impediments to the ascent of fish in the spawning season are removed; and when this is the case, artificial propagation will be no longer necessary.

MR. SETH GREEN, the well-known American pisciculturist, proposes that some enterprising persons should turn their attention to frog culture; and he gives careful directions for procuring and treating the spawn and frogs. The spawn will hatch in about fifteen days, and if the tadpoles and young frogs are placed in a suitable position it is calculated that they may be easily reared, and a large profit made. The mode of feeding the frogs is to place pieces of meat, or other substance, to attract the flies, upon which the frogs feed; they will also eat the maggots of decayed meat, and even the meat itself. It appears that the demand for frogs in America is increasing, and in that case a frog-farm might be made a good investment.

OF the 120,000 salmon eggs which were sent from England to New Zealand in the winter of 1872, only about 60 are now alive. Although the ship *Oberon* by which they were sent was only 93 days on the passage, she was delayed on her arrival at Dunedin in consequence of a quantity of gunpowder being on board, which was obliged to be discharged before she could get into port. Probably the eggs were not properly fertilised; though several boxes of ova which were kept packed in ice in England for 108 days under exactly similar conditions, produced a good percentage of fish. The Government of New Zealand intend to repeat the experiment this year, when Glasgow will be the port of despatch.

ON July 1 severe thunderstorms were felt in several parts of southern France, principally in and around Montpellier, which seems to have been a centre of electric manifestations. But the harm done was principally owing to the hailstones, which have been numerous and of considerable size, many of them reaching the bulk of a marble. Many crops were damaged, and even in some instances completely destroyed. These hail clouds travelled at a rapid rate from the eastern Pyrenees, near the Rhone, in a north-eastern direction for more than a hundred miles with a breadth of not more than eight or nine miles. A map will be published in the *Atlas Météorologique* of France, which was founded by M. Leverrier in 1864, and was published in 1864-68. The volume for 1869 will be issued shortly, and will contain the most notable facts for 1870-71. The publication, which has been stopped since M. Leverrier left the Observatory, will be resumed yearly henceforth, the Versailles National Assembly having granted the necessary funds. It has been remarked already by M. Charles Martin and the two Becquerels that hailstorms are always connected with thunderstorms, and follow mostly a strongly zigzag line, almost always recurring in a number of chosen spots, for which they seem to feel an irresistible attraction. Woods are very seldom touched by them, a fact which has induced MM. Becquerel to advise farmers to grow trees in order to be protected against hailstones. M. Arago encouraged some years ago a scheme for erecting captive balloons with an iron rod, connected with the earth by an iron chain, in order to provoke electrical discharges and suppress the cause of hail-production. The proposal seems to be rather daring, but the above statements render it desirable that it should at least be tried. Aiming at certain spots in preference to others, the efficiency of protection is sure to be easily tried. M. Colladon, a Genevan physicist, has published many experiments on the fall of lightning on trees. He supposes that poplars are really very attractive, and that they may effectually render the same service as true lightning conductors, if plates of iron are connected with the trunk and earth. These suggestions are very likely to be tried on a grand scale.

ICEBERGS seem to be unusually plentiful this season; a despatch from New York states that several ships have encountered them in uncommonly large numbers and of very unusual size.

MESSRS. TRÜBNER & CO. have in the press "Tea, Coffee, and Cocoa," a practical treatise on the examination of tea, coffee, and cocoa, by Mr. J. A. Wanklyn, M.R.C.S.

ANOTHER supplement, No. 37, to Petermann's *Mittheilungen* has just been issued, containing a long account of Carl Mauch's travels in the interior of South Africa in the years 1865-72. The accompanying map illustrates a journey made by Mauch in 1871-72, from Simbabye in 20° 10′ S., and 31° 40′ E. in a north and east direction, to Senna on the Zambesi, in 17° 20′ S., 35° 8′ E.

IF anyone wants to see how lamentable is the absence of practical work in the examination system of the University of London, let him get "Questions in Chemistry and Natural Philosophy given at the Matriculation Examination of the University of London from the year 1864 to June 1873, classified according to the syllabus of subjects," by C. J. Woodward, B.Sc. (Simpkin, Marshall, & Co.) We say nothing against the book itself, which is a creditable compilation of its kind, but the system capable of giving birth to such a text-book must be an unmitigated encouragement to "Cram."

A TELEGRAM dated Singapore, July 2, states that H.M.S. *Basilisk* had arrived there, having successfully completed a survey of the previously unknown north-eastern shores of New Guinea. Capt. Moresby reports that the existence of a new and shorter route between Australia and China is an established fact.

THE additions to the Zoological Society's Gardens during the past week include a Branded Ichneumon (*Herpestes fasciatus*) from West Africa, presented by Lady Sheffield; a Rose-ringed Parrakeet (*Palæornis docilis*) from the Zambesi River, presented by Mrs. Loveday; a Chimpanzee (*Troglodytes niger*) from West Africa; a Spectacled Bear (*Ursus ornatus*) from the Upper Amazon; an Eyra Cat (*Felis eyra*)) from South America; a Nisnas Monkey (*Cercopithecus nisnas*), an Eleonora Falcon (*Falco eleonoræ*) deposited; two Pumas (*Felis concolor*), and nine Rosy-billed Ducks (*Metopiana peposaca*) born in the gardens.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for June contains the following papers communicated to the Society:—On the cobalt bromides and iodides, by Walter Noel Hartley. The bromide is prepared by allowing metallic cobalt to stand in a dish with bromine and water for a week or so, when a purple solution is obtained which becomes blue after dilution and filtration. When evaporated over sulphuric acid, purple-red prismatic crystals separate, having the formula $CoBr_2 . 6H_2O$. When heated to 100° the salt loses 4 molecules of water. The iodide obtained in the same manner forms a mass of highly deliquescent green crystals. Heated to 100° in the air a basic salt is produced; on adding water and filtering a red oxyiodide is obtained, having possibly the formula Co_2I_3O. The green crystals have the formula $CoI_2 . 2H_2O$; an iodide, $CoI_2 . 6H_2O$, of a dusky red colour also exists, and likewise the anhydrous salt CoI_2, which is described as a black amorphous substance.—Note on the solubility of plumbic chloride in glycerin, by Charles H. Piesse. The author has made quantitative determinations of the amount of $PbCl_2$ dissolved by pure glycerin and by mixtures of glycerin and water. The mean of two experiments gives 1·995 as the amount of $PbCl_2$ dissolved by 100 parts of glycerin. The solubility is not perceptibly increased by the temperature. Experiments were also made with mixtures containing respectively 50, 75, and 87·5 per cent. of water, and the amount of $PbCl_2$ dissolved agrees very closely in each case with the number obtained by adding the amount of the salt dissolved in the water to the amount dissolved by the glycerin, the solubility in water being taken at 0·733 per cent.—On the products of the decomposition of castor oil. No. 2. The distillation of sodium ricinoleate, by E. Neison. The author's experiments confirm the statements of Bouis, that the sodium salt named yields methyl-hexyl ketone on destructive distillation. The results obtained by Städeler, who got by this reaction only heptylic aldehyde, are explained by a difference in the nature of the soap used.—Note on a reaction of gallic acid, by Henry R. Procter. When a solution of potassic or sodic arsenate is added to one containing gallic acid and the mixture exposed to the air, oxygen is absorbed, and an intense green colour produced. Dilute acids change the colour to purplish red—strong H_2SO_4

and HNO_3, and boiling HCl change it to a pale yellow. The colour is also destroyed by reducing agents.—On ozone as a concomitant of the oxidation of the essential oils. Part I. by Charles T. Kingzett. The author first determined the amount of oxygen absorbed by ether, oil of turpentine, and various essential oils. Various reactions of the so-called ozonised oil of turpentine have been studied. The oxidised substance resembles both ozone and hydrogen peroxide in certain properties, but its aqueous solution retains its properties after long-continued boiling. The substance is destroyed also by MnO_2 and by heating with $ZnCl_2$. The author concludes from his experiment that the supposed ozone is an oxidised compound of the turpentine oil, $C_{10}H_{16}O.H_2O$.—It is much to be regretted that the Society still finds it necessary to advertise on the wrapper of the present number (as also of the last) a list of books missing from the library.

American Journal of Science and Arts, June.—The first article is by W. Hilyard, Univ. of Michigan, On some points in Mallet's theory of vulcanicity. He gives a *résumé* of the state of the question. Among other points considered Mr. Hilyard says:—"While Mr. Mallet's theory accounts satisfactorily for earthquake phenomena and volcanic activity as manifested since the cessation of fissure eruption; and also for the gradual or sudden depression of both large and small areas, even subsequent to that time; it makes no provision for their elevation, and therefore leaves unexplained the numerous oscillations of level of which we find the record down to our own time. In assuming the movements as taking place exclusively within the solid shell, he (unnecessarily, it seems to me) leaves a point open to objection." . . . "At the first blush the 'squeezing out of sub-mountain liquid matter' assumed by Leconte as the consequence of the folding and fissuring of strata by tangential thrust, appears natural enough. Yet it seems hardly possible that the same force which makes and elevates mountain-folds (being the result of interior shrinkage) should at the same time serve to compress the interior liquid, unless either such folding occurs beneath the general level of the liquid; or the latter is locally confined; or the movement is so brusque or cataclysmal that viscosity would prevent the lateral or downward escape of the liquid rock." While the assumption of locally limited fire seas, as proposed by Dana, would remove the difficulty, calculation shows the required size of the seas to be such that they would approach to nearly a general undercrust fluidity.—In the second article Mr. L. Lesquereux replies to Dr. Newberry's objections to the Colorado Lower lignite formation being referred to the period of the Lower Eocene. He shows that many of the species it contains are common to Alum Bay and Mount Bolca, and he objects to Heer's statement that the floras of these two localities have "a distinctly tropical and Indo-Australian character." The next article is a continuation of Mr. C. H. Hitchcock's paper On the Helderberg rocks of New Hampshire. The beds in question border on the line of the Ammonoosuc River in three areas, the Littleton, North Lisbon, and Lyman. Of the fossils Mr. Billings says: "I do not consider the fossils sufficient to decide the age of the rock very closely, but only that it is Upper Silurian or Lower Devonian.' The communication, which occupies twenty pages, is illustrated with map and sections.—A description of a new fossil resin, by O. Loew, named by him Wheelerite. Its formula is C_5H_6O, and it melts at 154° C.—The next article is a completion of Mr. W. M. Fontaine's paper On the great conglomerate on New River, West Virginia. This series, while in some features resembling the lower coal rocks, is distinguished by an almost entire absence of shales. The study of it has led to the consideration, "Does not the successive formation of coal on an extended scale along the south-west border of the Appalachian coal-field, commencing in the Devonian period, point to the existence at this time of a continental mass nearer than the azoic of Canada?"—On a felspar from Bamle in Norway, by G. W. Hawes.—Notes on some fossils in Illinois State Geological Reports, vol. v., by F. B. Meek.—Chemical composition of the wood of Acrogens, by C. W. Hawes. The analyses show that the wood of Acrogens does not differ in ultimate composition from forest trees.—Under the head "Scientific Intelligence," there is a note that a skeleton of a whale (*Beluga vermontana*) has been found at a depth of 12 ft. 6 in. in clay of the Champlain period, at Jacquet River, Dalhousie, New Brunswick.—The flora of the Dakota group of the Cretaceous is, according to Mr. Lesquereux, remarkable for the absence of any European species of the same age.

THE *Geographical Magazine*, July.—This number opens with an interesting sketch of the history of Indian Marine Surveys.—Col. H. Yule, C.B., contributes an abstract from the *Bulletin* of the St. Petersburg Geographical Society of Mr. F. Paderin's account of his visit to the site of Karakaroum in 1873, which is illustrated by a sketch-map.—Another paper by Col. Yule contains some valuable information concerning the wonderfully accurate *Atlas Sinensis* (1655) of the Jesuit Martin Martini.—A number of valuable notes on the Kashgar Mission are given in the form of letters from Lieut.-Col. Gordon and Capt. Biddulph.—Baron von Richthofen sheds considerable light on the question of land communication between Asia and Europe. No one is entitled to speak with more authority than this great explorer of China, and he distinctly states that "the trade-route from Si-ngan-fu, past Hami, to Kuldja, is the best natural line for a railway from China to Europe." He is confident of the practicability of the undertaking.

THE *Journal of Botany*, May, June, July.—The number for May commences with a short sketch of the life of a little-known botanist, William Sherard, a contemporary of Ray, who died in 1728, and bequeathed his library and herbarium to the University of Oxford, together with an endowment of 3,000*l*., for the Professor of Botany.—Mr. F. A. Lees has a useful paper On the flora of the Yorkshire coal-field.—Prof. Thiselton Dyer appends some remarks to a translation of M. Vesque's paper On new species of Dipterocarpus, from the *Comptes Rendus*, some of M. Vesque's names having a claim of priority over those published by Prof. Dyer in the preceding number of the *Journal*, while others appear identical with previously described species, and to have been published on insufficient grounds.—In the number for June the papers are mostly of a character to interest species-botanists only.—Mr. J. G. Baker describes some new species of Dracæna from Tropical Africa.—The same remark may be applied to the number for July, with the exception of an account of the Botanical Congress at Florence, continued from the preceding number, and reprints of the Official Reports of the Keeper of the Botanical Department of the British Museum, and the Curator of the Herbarium and Library at Kew for 1873.—One or more plates in every number now add to the permanent value of this admirably conducted magazine.

IN the *Scottish Naturalist* for July, we find papers on Scotch zoology, phytology, and geology. We would call special attention to one by Mr. G. Sim, On the food and use of our rapacious birds, an eloquent appeal for the protection of our "Raptores," which are now becoming scarcer every year. From an examination of the stomachs of 305 birds which have passed through his hands during the last ten years, eagles, buzzards, ospreys, falcons, merlins, kestrels, sparrow-hawks, owls, &c., the author has come to the conclusion that the injury done by these birds to the farmer and game-preserver is very small compared to the benefit, by far the most abundant articles of their food being mice, shrews, and various insects. Even when hawks do kill game, he maintains that it is the weakly and sickly birds that fall victims.—Mr. F. Smith concludes his paper On the geology of the Earn Valley, and Dr. Buchanan White and Dr. Sharp give further instalments of the Lepidoptera and Coleoptera of Scotland.

THE *Transactions of the Linnean Society* has now entered on its thirtieth volume. The first part, just published, contains Mr. J. Scott's paper On the tree-ferns of British Sikkim, illustrated with eighteen plates; a paper On some recent forms of *Lagenæ* from deep-sea soundings in the Java seas, by F. W. O. Rymer Jones, with one plate; an enumeration of the Orchids collected by the Rev. E. C. Parish near Moulmein, by Prof. H. G. Reichenbach, f., with six plates; and a most elaborate and laborious monograph of the habits, structure, and relations of the three-banded armadillo, *Tolypeutes conurus*, by Dr. James Murie, with seven plates.

Memorie della Societa degli Spectroscopisti Italiani, May.—Secchi and Tacchini contribute a table showing the solar prominences for November and December 1872, in which there is a marked aggregation of prominences on either side of the solar equator and a total absence at the poles.—There is also a coloured plate of some prominences and faculæ, by Gautier.—Schiaparelli gives an account of Capt. Tupman's observations on shooting stars, accompanied by a table showing the length of the trajectory in degrees and duration of numbers of meteorites.—Lorenzoni gives a discussion of the results of the researches at the Vienna University on the orbits of meteorites, with a table showing the elements of sixteen meteor streams.—Prof. Bredichin gives his solar observations for last autumn, together with a discussion on the formation of prominences.—Tacchini gives his observations on solar spots for May 1874.

Astronomische Nachrichten, No. 1,997.—This number contains an account of the observations of the minor planet Virginia since its discovery in 1857, and the following elements are calculated :—

1874, June 19, Berlin.

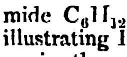
$$\begin{aligned} M &= 322^\circ\ 19'\ 49''\cdot80 \\ \pi &= 10\ \ 0\ 42\cdot76 \\ \Omega &= 173\ 27\ 39\cdot0 \\ i &= 2\ 47\ 53\cdot5 \\ \phi &= 16\ 37\ \ 4\cdot3 \\ \mu &= 822''\cdot710835 \\ \text{Log. } a &= 0\cdot4231729 \end{aligned}$$

An ephemeris is also added for the opposition this summer.—Doberck contributes new elements for Comet I., 1824, deduced from Rümker and Sir J. Brisbane's observations.—Some observations of position of Henry's Comet, 1873, are given by J. J. Plummer.—No. 1,998 contains a paper on the photographic processes applicable to the transit of Venus.—C. S. Sellack contributes a paper on the direct photography of the solar protuberance.—A communication on the elements of the orbit of Alceste is made by A. Hall, corrected by observations made at Washington.—M. Flammarion gives the following periods of double stars :—

	Years.	Apparent semi-axis major.	Perihelion passage.
ξ Ursa Majoris . .	60·60	2″·45	1873·40 at 358°
ζ Herculis	34·57	1·19	1864·35 at 298
η Coronæ Bos . . .	40·17	0·865	1853·95 at 287
γ Virginis	175·	3·385	1836·45 at 320

No. 1,999.—This number contains an ephemeris of the five inner satellites of Saturn from June 1 to Oct. 28, by A. Marth, and a discussion of the various theories of comets, by W. Zenker.—In No. 2,000 is an account of some spectroscopic observations on certain variable and other stars, by H. C. Vogel; the author gives the wave-lengths of the lines in some cases.—G. Strasser gives a number of observations on comets (Winnecke and Coggia), together with the list of comparison stars.—C. H. F. Peters contributes observations on some of the planetoids, and A. Krüger gives some position observations of Coggia's comet.

Justus Liebig's Annalen der Chemie und Pharmacie, Band 172, Heft 1. This number contains the following papers :—A condensation product of glyoxal, by Hugo Schiff. Glyoxal is dissolved in five or six volumes of strong acetic acid and a stream of hydrochloric acid gas passed through the solution for about fifteen minutes. The solution on standing deposits a white substance, which was found to possess the composition $C_{12}H_{14}O_{13} = 6C_2H_2O_2 + H_2O$, and which the author proposes to name *hexaglyoxal hydrate*. Treated with acetic anhydride, one atom of hydrogen is replaced by acetyl, giving the compound $C_{12}H_{13}(C_2H_3O)O_{13}$; similarly with benzoyl chloride the compound $C_{12}H_{13}(C_7H_5O)O_{13}$ is produced. The author concludes from these reactions that the substance contains *one* semi-molecule of hydroxyl.—Improved air-bath for heating sealed tubes, by J. Habermann.—On the oxidation products of amylum and paramylum with bromine, water, and oxide of silver, by the same. Amylum yields dextronic or glucosic acid $C_6H_{12}O_7$, and paramylum the same. The calcium, barium, and cadmium salts of the acids were examined.—On the sodium contained in the ashes of plants, by G. Bunge. The author is of opinion that the result obtained by Peligot, who found that the ash of beans was free from sodium, is due to some error in the method of determination employed. An examination of the analytical method employed by Peligot has been undertaken, the results of the analysis of the ash of cows' milk being given as an example. This examination leads the author to the conclusion that by determining the alkalies merely in the aqueous extract of the ash, not only is a low value obtained, but the ratio between the two bases is a false one. Details of the method of analysis adopted are next given, and its application to the ash of beans, clover, meadow grass, apples, and strawberries. The author remarks that by his analyses Peligot's conclusions are not refuted, but at the same time they cannot be considered as established on the grounds of the analyses made by that chemist.—On oxysulphobenzide and a new derivative of this substance, by Dr. J. Annaheim. The following substances are described in this paper :—Oxysulphobenzide, $\left(\left.\begin{matrix} C_6H_4HO \\ C_6H_4HO \end{matrix}\right\} SO_2\right)$; Phenoltrisulphonic acid,



$C_6H_2SO_3H$ with HO above and $(SO_3H)_2$ below;

Tetrachloroxysulphobenzide, $\left.\begin{matrix} C_6H_2Cl_2OH \\ C_6H_2Cl_2OH \end{matrix}\right\} SO_2$, and the corresponding bromine and iodine compounds; methyloxysulphobenzide, $\left.\begin{matrix} C_6H_4OCH_3 \\ C_6H_4OCH_3 \end{matrix}\right\} SO_2$; the dinitromethyl compound, $\left.\begin{matrix} C_6H_3NO_2OCH_3 \\ C_6H_3NO_3OCH_3 \end{matrix}\right\} SO_2$; the diamido compound, $\left.\begin{matrix} C_6H_3NH_2OCH_3 \\ C_6H_3NH_2OCH_3 \end{matrix}\right\} SO_2$; the ethyl compound, $\left.\begin{matrix} C_6H_4OC_2H_5 \\ C_6H_4OC_2H_5 \end{matrix}\right\} SO_2$ the corresponding amyl compound, and their nitro-, amido-, and brominated substitution derivatives.—The concluding paper is by Otto Hecht and Julius Strauss : On normal hexylene and some of its derivatives. The authors have examined the dibromide $C_6H_{12}Br_2$, and the monobromide, $C_6H_{11}Br$.—A plate illustrating Habermann's paper On an improved air-bath accompanies the present part.

SOCIETIES AND ACADEMIES

LONDON

Anthropological Institute, July 1.—Special meeting at the East London Museum, Bethnal Green.—Prof. Busk, F.R.S., president, in the chair.—Col. Lane Fox read a paper on the principles of classification adopted in the arrangement of his anthropological collection exhibited in the East London Museum. The paper contained three divisions, viz. Psychological, Ethnological, and Prehistoric. The author's object had been, during the twenty years he had been occupied in forming the collection, to select the specimens not so much for their rarity or beauty as for their utility in illustrating the succession of ideas by which the minds of men in a primitive condition of culture had progressed from the simple to the complex. Contrary to the usual system of arrangement, which was geographical, and was to be found in most ethnographical museums, the author's primary arrangement had been guided by form, *i.e.* spears, bows, clubs, &c. had been placed by themselves in distinct classes; and within each class there were sub-classes for special localities, and in each of the sub-classes the specimens were arranged according to their affinities. It was shown how far the arts of existing savages might be employed to illustrate the relics of primeval men. In studying the evidence of progress, the phenomena that might be observed were (1) a continuous succession of ideas; (2) the complexity of the ideas in an increasing ratio to the time; (3) the tendency to automatic action upon any given set of ideas in proportion to the length of time during which the ancestors of the individual have exercised their minds in those particular ideas. After a lengthened elaboration of those psychological considerations Col. Fox pointed out that the forms of implements used by savage races, instead of affording evidence of their having been derived from higher and more complex forms, showed evidence of derivation from natural forms, such as might have been employed by man before he had learned the art of modifying them to his own use; and that the persistency of the forms is in proportion to the low state of culture. That conclusion was illustrated by reference to the Australian and other savage peoples. The third and concluding part of the paper was devoted to the correlation of modern implements in use among existing savages with those of Prehistoric times.—The reading of the paper was followed by an explanation of the collection, which was arranged with a view to illustrate the principle of sequence contended for by the author.

PHILADELPHIA, U.S.

Academy of Natural Sciences, Dec. 23.—Dr. Ruschenberger, president, in the chair.—Prof. Cope made some remarks on fishes from the coal measures at Linton, Ohio. He stated that Prof. Newberry, Director of the Geological Survey of Ohio, had sent to him numerous specimens of fishes and batrachians for determination and description. Among these he had discovered batrachians which were labelled and had been described as fishes (*Pygopterus scutellatus* Newb.), and fishes (*Conchiopsis* and *Peplorhina* Cope) some of which were labelled "Amphibian or Reptilian." Having determined the latter to be fishes and described them, he called attention to a note of Prof. Newberry on the latter, in which he states (1) that *Peplorhina anthracina* is a batrachian; (2) that it is identical with *Conchiopsis exanthematicus*; (3) that *C. filiferus* is *Coelacanthus elegans*; (4) that the dentition described by him is not that of *Coelacanthus*; and that (5) the genus is the same as that described by Agassiz forty years ago as *Coelacanthus*. To these propositions Mr. Cope replied that (1) additional evidence derived from two specimens of *Peplorhina anthracina*, recently studied, confirms the view that it is a fish, which evidence is given below; (2) that neither of the two specimens exhibits in its cranial bones the characters of *C. exanthematicus*, though both sides are exhibited. They show, however, that the latter should be referred to the genus *Peplorhina*, since among other points they present the same type of teeth, which I find labelled on one of them "ova?" (3) Mr. Newberry's identification of the species *C. filiferus* with *Coelacanthus elegans* is doubtless correct; but (4 and 5) its reference (with that of similar species) to Agassiz's genus is not warranted until it is found to possess an osseous natatory bladder, and osseous ribs and the type of dentition are discovered in *Coelacanthus granulatus*, the type of the genus. The characters relied on as indicative of the reference of *Peplorhina* to the fishes, are (1) the presence of opercula like those of *Conchiopsis*; (2) the presence of jugular bones, and (3) of oval imbricated scales; (4) the absence of ambulatory limbs. The thin scutiform cranial bones, the dense patch of vomerine teeth, and the mucous ducts of the bones and scales were all ichthyic characters. As no limbs had been discovered in three specimens preserved in the appropriate regions, their nature, if existing, could not be determined at present.—Prof. Cope brought before the Academy some results derived from study of material obtained by him during the preceding summer in the Miocene formations of Colorado. He announced the discovery of the first fossil monkey of the Miocene of America, giving it the name of *Menotherium lemurinum*. He regarded it as allied to the *Tomitherium* of the Bridger Eocene, and as the representative of the more numerous group of the lemuroids, which he had discovered in the latter formation. Size, that of a domestic cat. He stated that his recent discovery of snakes, lizards, and lemurs of forms allied to those previously discovered by Prof. Marsh and himself in the Eocene of Wyoming, constituted points of affinity to the fauna of that period not previously suspected. He also observed that he had discovered some additional species of *Ruminantia* allied to the musk, and to the *Leptomeryx evansii*, which he named *Hypisodus minimus*, and *Hypertragulus calcaratus*, and *H. tricostatus*. The first was the least of the order, not exceeding a cat-squirrel in size. *Hypertragulus* differs from *Leptomeryx* in the isolation of the first premolar, as in the camels, and in the sectorial character of the penultimate premolar.—On circulatory movement in Vaucheria. Prof. Leidy made some remarks on the intracellular circulation of plants, as exemplified in the hairs of the Mullein, the leaf-cells of Vallisneria, &c. The moving streams of protoplasm he likened to amœboid movements, and expressed the opinion that they were of the same character. In the common alga, *Vaucheria*, the filaments of which consist of very long cells, comparable to those of Nitella or Chara, he had observed an apparent motion of the cell contents, which is somewhat peculiar and, at least, is not generally mentioned by writers. The wall of the cells is invested on the interior with a layer of tenacious protoplasm, containing the thinner liquid cell contents as usual. The parietal protoplasm is closely paved with green granules, and these appear very slowly but incessantly to change their position in relation with one another. The motion is so slow that it was a question for some time whether it did actually occur, but it appears sufficiently obvious if observed in relation with the lines of a micrometer, and its existence was confirmed by several friends whose attention was directed to it.

PARIS

Academy of Sciences, July 6.—M. Bertrand in the chair.—The following papers were read:—Presentation of a specimen of the photographs of an artificial transit of Venus obtained with the "photographic revolver," by M. J. Janssen.—Researches on solution, crystallisation, precipitation, and dilution, by M. Berthelot. This is a continuation of the author's important researches in thermo-chemistry. The thermal effects accompanying coagulation, the transformation of an amorphous into a crystalline substance, and the mixture of two saline liquids are now treated of. A differential method for measuring the specific heats of dilute solutions has been introduced.—On parasitism and contagion, by M. Ch. Robin.—M. Dumas made some remarks in reply to the foregoing paper.—On the spectrum of Coggia's comet, a letter from P. Secchi to the perpetual secretary. The author has observed that of the three carbon bands the green is the brightest, while in Tempel's comet the yellow was the brightest, a fact which proves that the gaseous combinations are not rigorously the same for all comets. It was further stated that at the beginning of the month only the band spectrum was visible, but now a general line of connection exists, forming a quasi-continuous spectrum through the centres of the bands. A drawing of the spectrum accompanied the paper.—On the photographic apparatus adopted by the Transit of Venus Commission: reclamation of priority; extract from a letter from Col. Laussedat to M. Dumas.—On the method of employing carbon disulphide in the treatment of vines attacked by *Phylloxera*, by M. Fouque.—In mathematical analysis:—On osculatory surfaces, by W. Spottiswoode.—Note on orthogonal surfaces, by M. E. Catalan, and Reply to the observations of M. Combescure, by M. l'Abbé Aoust.—M. Praznowski presented (through M. Janssen) a note on the helioscope. This instrument is designed by the author for diminishing the brilliancy of the sun's image by polarisation.—On the diffusion of light and the illumination of transparent bodies, by M. J. L. Soret. By examining quartz, amethyst, diamond, and other crystals, the author has concluded that the illumination of non-fluorescent transparent crystalline substances is always due to want of homogeneity.—On the formation of solar spots, by M. Tacchini. The author sees no confirmation of the cyclone theory of sun-spots in the detailed observations of the chromosphere made in Italy, America, and England. Some solar observations for June were also communicated, from which it appears that the sun was in a state of great activity during that month. On the 11th Mg. was reversed all round the sun's limb: on the 4th two double lines (4,924-5,018) were reversed on the western limb, and on the 11th they occupied nearly all that limb and encroached upon the eastern border. A great eruption took place on the 10th, when all the lines from *b* to 1,474 were seen reversed.—Researches on electric transmission through ligneous bodies, by M. Th. du Moncel. The author's experiments show that wood owes a considerable portion, if not all, its relative conductivity to moisture contained in the pores.—On the embryology of *Rhizocephalus*, by M. A. Giard. These animals constitute a Cirrhipedian group.—On the male accessory glands of some animals and on the physiological rôle of their product, by M. P. Hallez.—On the movement of the stamens of *Sparrmannia africana* L., of *Cistes* and of *Helianthemum*, by M. E. Heckel.—On the existence of diatoms in different geological formations, by M. l'Abbé Castracane.—Carboniferous limestone of the Pyrenees. Marble of Saint-Béat and of Mont (Haute Garonne), by M. F. Garrigou.—A neolithic flute, by E. Piette.—On a scab of the horse of intermittent character caused by an acarus, presenting the singular peculiarity of being psoric during winter, and simply parasitic during summer, by M. Mégnin.—Experimental researches on the action of water injected into the veins, from the point of view of pathogeny and uremy, by M. Picot.—Analyses of beers and malts, by M. Ch. Mène.—On the extraordinary hailstorm which fell in the department of Hérault during the night of June 27-28; extract from a letter from M. J. Gay to M. Ch. Sainte-Claire Deville. The loss of vines is stated to be valued at 50,000,000 francs.

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The progress due to the stimulus of scholarships is from these reasons slow, though perceptible; and the friends of science have been looking therefore to the Royal Commissions on Scientific Instruction, and on the Public Schools, to supply a stimulus from another quarter.

The proposed "Regulations" of the latter Commission which have just been issued will be welcomed by those who heartily wish for the progress of Science Teaching. Ignoring, of course, the question of University scholarships, they indirectly settle it by placing science on exactly the same level as mathematics, and enforcing the necessary outlay for its efficient teaching. And there can be little doubt that this is the right end at which to begin the reform, for it is a narrow view to consider the Universities as making the demand by offering rewards, and the schools as affording the supply. It is the public that demand scientifically educated men, and the schools first, and then the Universities, are called upon to supply them.

These Regulations apply, of course, to a very limited number of schools, some of which have already done much that is now required of them; but they are the most important schools in the kingdom, and will inevitably influence all others by the standard thus set. If these Regulations be confirmed the nail will be driven home, and science will be established as a necessary part of every public school curriculum.

The following are the Regulations to which we especially draw attention, and which are common to all the schools in the view of the Commission:—

"2. In every examination determining the position of a boy (not being one of the senior boys) in the school, or in any report of a general examination, the proportion of the marks to be assigned to mathematics shall be not less than one-eighth, nor more than one-fourth, as the governing body may think fit.

"3. In every examination determining the position of a boy (not being one of the senior boys) in the school, or in any report of a general examination, the proportion of the marks to be assigned to natural science shall be not less than one-eighth, nor more than one-fourth, as the governing body may think fit.

"4. In any examination for the senior boys, the proportion of the marks to be assigned to the several subjects of study shall be determined by the head master, with the approval of the governing body.

"5. The governing body shall from time to time determine the point in the school list above which the boys shall be reckoned as senior boys for the purposes of these regulations.

"6. The head master shall give facilities so far as practicable to any senior boy, at the request of his parent or guardian, to pursue any particular subject or subjects of study as may be deemed most expedient for him, and to discontinue any other subject or subjects of study for that purpose.

"7. The governing body shall, as soon as possible, provide and maintain out of the income of the property of the school, or out of any other means at their disposal for the educational purposes of the school, laboratories, and collections of apparatus, and of specimens."

It will be observed that the wording of Nos. 2 and 3 is identically the same, except the substitution of the words Natural Science for Mathematics—thus placing these two subjects upon exactly the same level. With regard to the limits one-fourth and one-eighth, taking it as approximately correct that the proportion of marks in an examination will be that of the time devoted to the subject, these two together will require at least one-fourth of the whole time, a larger proportion than is now given to mathematics in most schools, especially with those who are not "senior boys;" and thus an encroachment on the classical time is involved, and this lower limit is not likely, therefore, to be much exceeded, in these great schools at all events. But even this will insure greater breadth than under the old system, and will secure that every boy shall know something of the elements of science before he goes on to the elegancies of classics.

The individual character, however, of particular schools is not interfered with, for this depends essentially on the work of the senior boys; and for them by Regulation 4 the head master may arrange the marks to suit the old traditions of the school. Yet, when we consider the effect of Nos. 6 and 7, we may doubt whether the individuality will continue so well marked. For with laboratories to work in, and specimens to handle, and facilities to pursue their favourite subject, it is impossible but that some fair proportion of the scholars should be attracted by the charms of physical investigation or of natural history, and mix the honours of the school.

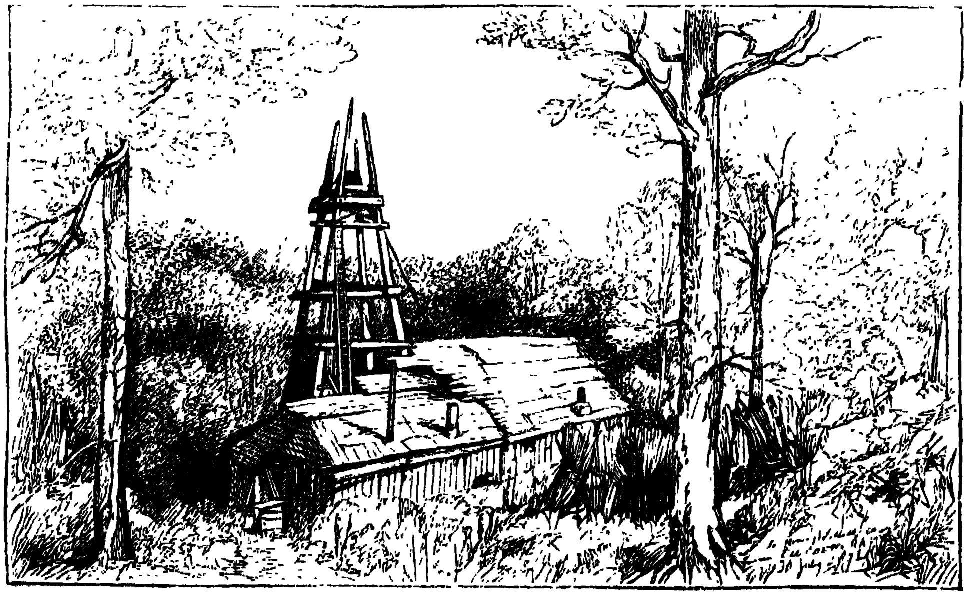
Of all the proposed Regulations, however, the most pregnant with consequences is the last.

There is no need surely in these days to insist on the absolute necessity for "laboratories and collections of apparatus and of specimens," if science is to be taught at all; and we may look, therefore, on this as simply the definition of the term "Natural Science;" it is not book learning, but science learnt from Nature herself by practical work. If a governing body be called on to provide such laboratories, we may rely on it that for the credit of their school they will do it well, and a good laboratory leaves only a good teacher to be desired, and itself helps to form and train him. The confirming of this Regulation will be a great step towards that much-to-be-desired state of things when a laboratory will be considered as necessary a part of a school as a class-room, bottles and bones as essential as books and boards. But we must not ignore what has already been done in schools like Eton and Rugby; with their laboratories and museums, such a Regulation is superfluous; but with the good work which has been accomplished before us, we have a happy omen of the result of the universal application of the principle they have voluntarily adopted. It is from these schools and others not included in the "nine," that have not fitted up their laboratories, that the Natural Science scholars are obtained, and perhaps the proportion of such scholarships to all others is as great as that of schools with laboratories to those without—probably greater. As the number of science-teaching schools increases the number of scholarships must increase too, but not at the same rate; the proper and final proportion may be left to settle itself.

On the whole we may regard these proposed Regulations with the greatest satisfaction, and it is probable that they will be looked back upon as the charter of the country's progress in scientific education. Individual efforts have been made on a grand scale, and natural science is making its way more or less efficiently into all good schools, while some are devoting themselves chiefly to its cultivation, as Taunton, Giggleswick, Burnley; but universal recognition, its acquirement of *prestige*, and consequent respect and earnest study, with the national advantages to be derived from it, can only be secured by such Regulations as these, followed or not as may be necessary, by similar ones for all the larger endowed schools.

THE SUB-WEALDEN EXPLORATION

IF the word *romance* were to be imported into scientific literature there could surely be no more fitting application of it than to this recent crusade into the bowels of the earth among the woods and lanes of Sussex. Down in that southern part of the country, some hundreds of miles away from the great centres of our mineral industry, with no prospect of any pecuniary reward or of any immediate economic advantage, men are found willing to subscribe money to the extent of thousands of pounds for the purpose of settling definitely some important questions in the geology of the south-east of England, viz. at what depth from the surface the secondary strata are underlain by a ridge or platform of old Palæozoic rocks, what are the nature and age of these bottom rocks of the district, and what is the arrangement of the strata lying between them and the surface. It has long been a problem of much interest to geologists to discover whether or in what manner the great series of Jurassic rocks, which stretches across our island from the coasts of Dorsetshire to those of Yorkshire, passes south-eastward underneath the chalk. That series has been found to grow thinner towards the south-east. On the French side of the Channel it reappears in the Boulonnais, coming out from under the Cretaceous strata and resting against a ridge of Palæozoic rocks which rise to the surface between Boulogne and Calais. Nearly twenty years ago Mr. Godwin Austen drew attention to the probable extension of this ridge underneath the later formations of the south-east of England and its connection with the Carboniferous tracts in our south-western counties. It was a point of great interest in any attempt to reconstruct a map of the physical geography of western Europe during Palæozoic times. Hence, at intervals since the publication of Mr. Austen's great memoir, renewed attention has been given to the subject, until at last the idea took shape that a bold attempt should be made to settle some portion at least of the problem by putting down a bore and keeping it going, if possible, until all the Secondary rocks should be pierced and definite information should be obtained as to what lies below them. Advantage was taken of the meeting of the British Association at Brighton in 1872 to organise the scheme. For so purely scientific a project it was of course natural to look for help mainly to such well-wishers



The Sub-Wealden Exploration in Sussex—Boring at Netherfield. (Kindly lent by the Proprietors of the *Graphic*.)

to science as attend the Association meetings, rather than to the general public. Subscription lists were opened and money came in, not in overflowing abundance indeed, but yet in quantity sufficient to enable the operations to be begun. Further donations have been given, and the work has now been carried down to a depth of more than 1,000 ft.

It would be a great misfortune to science if this undertaking, after having been successfully carried so far, were now to be brought to an abrupt close for want of funds. Already the boring has put us in possession of some new and important facts in the geology of the south-east of England. It has shown that the well-known Kimmeridge clay stretches underneath the later Secondary rocks as a deep massive formation, some 700 ft. in thickness, and that it lies upon and appears to pass down into the Oxford clay without the intervention of the sandy and calcareous beds which usually separate the two deposits. The geological position of these clays is settled by means of the fossils, of which literally thousands have been taken out of the 2-in. core of rock brought up by the diamond-boring machine. It is intended, we believe, to sort the specimens and distribute them among different public museums. How much further the bore must be sunk before the remainder of the Secondary strata is pierced, to what horizons these strata will be assignable, and what will be their basement rocks, are the parts of the problem still to be solved.

Though undertaken chiefly in the interest of pure science, the project has likewise its economic aspects. It is eminently desirable to know whether any minerals of value lie among the Secondary rocks of the south of England, such as iron-stone, rock-salt, or gypsum; whether among the Palæozoic rocks underneath there is any possibility of obtaining workable coal or any of the other minerals which have made the Carboniferous formations so valuable a source of our wealth. It is likewise greatly to be wished that as full and accurate information as possible should be obtained regarding the nature of the rocks underneath with reference to the question of water-supply—a question which, important enough now, is certain before many years to become one of the most pressing social problems of the day.

On every ground, therefore, this most heroic attempt to provide data for settling some of these questions deserves hearty encouragement. On no account must it be allowed to come to an end till its express object is accomplished. If every well-wisher to science in this country would but send his contribution, not only would the present boring be conducted to a successful issue, but a great series of similar borings might be made all over the south of England. We understand that the Government, impressed with the interest and importance of the subject, has promised to contribute a sum of 1,000*l.* conditionally upon coal being found or on the boring being continued for another 1,000 ft. This aid will be valuable, but it evidently in the meantime does not supersede private efforts; it rather makes them more needful than ever. The undertaking is in excellent hands. Mr. Topley, of the Geological Survey, looks after its geological aspects. To Mr. Henry Willett, of Arnold House, Brighton, the zealous and indefatigable honorary secretary, the enterprise is mainly indebted for its financial progress so far. He has now appealed earnestly for further help, and to him we would urge all who take interest in these matters, and who have not already contributed, to send their donations, which, whether small or large, will at the present moment be of the most essential service.

A. G.

THE SCIENCE OF PAINTING

Die Farbenlehre im Hinblick auf Kunst und Kunstgewerbe. Von Prof. Wilhelm von Bezold.

THERE are two ways of popularising science. We may take up one of its great branches and treat it so simply and clearly that even the unscientific reader may with proper attention gain some insight into the principles to which the recent great advances in science have been chiefly due; or we may take up a smaller field and treat it fully and with all its applications in everyday life. He who studies a subject by the latter method will have it constantly brought under his notice, and will thus be led to observe and perhaps to experiment, and to acquire for himself that method of looking at the phenomena of nature and reasoning about them which is necessary to the understanding of every great principle in science, but which is foreign to nearly all who have not had a scientific training.

The latter method, which no doubt will prove the most successful, has been chosen by Prof. von Bezold in his work on the theory of colours. No subject is better fitted to be treated in this way, because it is in everybody's power to make observations, and perhaps even to find out some new fact. It is, however, not the only, and not even the chief, object of the author to create merely an interest in his subject outside the scientific world. He wishes his book to be of real value to the artist and to help him by theoretical speculations to such combinations of colour as shall prove most effectual. It is very doubtful whether the book will be successful in this respect. No doubt it would be a great achievement if every artist could be induced to think about the cause of the various and curious effects which are brought about by contrast and combination of colours; we therefore recommend the careful perusal of Prof. von Bezold's book to every painter. In the present state of the theory of colours, however, the attention bestowed upon it by artists will be of greater value to the subject than to themselves. It would no doubt be injurious to art if the painter were guided in his work by a theory so long as that theory is incomplete.

Painters are, however, themselves best able to bring the theory of colours into a better state; a state in which it will be beneficial to themselves and repay them for their trouble.

Two things have chiefly struck us in Prof. von Bezold's book as adding to its value and interest. The first is the care which he has taken to give his experiments in such a way that anyone without the use of large and expensive apparatus can repeat them and test for himself the truth of the author's statements. The second is the great ingenuity with which the author explains by his theory so many of the phenomena which most of us daily observe. We note one particular instance. All who have worked much at absorption spectra must have been struck by the change of colour which light of a certain wave-length undergoes when the intensity diminishes. Prof. von Bezold uses this curious fact to explain the peculiar colours seen in a landscape when viewed by moonlight, although the light reflected by the moon is identical in composition with sunlight.

In his account of the elementary principles of optics the author abandons the old method of dividing vibrations into heat rays, light rays, and actinic rays. We note this point as it is one which must soon play an important part in physics and will doubtless provoke much discussion. The author seems to prefer the following method of viewing the facts to the old one:—A body absorbs a certain class of rays peculiar to itself; whether these rays are converted into heat or into chemically active rays depends upon the peculiar properties of the body. In order, however, to include in this statement all the facts included in the old division, we must add that, as a rule, bodies absorbing the ultra-violet rays are thereby rendered more chemically active, and, as a rule, bodies absorbing the red are thereby heated. This method of looking at the matter seems to us to be the one most closely agreeing with the facts. Prof. von Bezold gives, as a proof that the red rays may be chemically active, the fact that, as the green colouring matter of leaves absorbs the red end of the spectrum as well as the blue, the red rays alone are sufficient to sustain life in the plant. He might have referred to the recent discovery of Vogel, who photographed the red end of the spectrum by mixing a red colouring matter with bromide of silver; and, on the other hand, to the fact observed by Budde, that chlorine is heated by the ultra-violet rays. The third chapter contains a short and clear abstract of recent researches on compound and primary colours. We would call attention specially to the passage in this chapter on colour and sound, in which the author refers to the influence of dwelling too much on the analogy between sound and light. Analogies are a very dangerous help to teachers, and are used by far too often. It requires at least a partial knowledge of the subject to see where the analogy begins and where it ends. Students generally either do not see where the analogy really lies, or want to carry it too far; a good many erroneous notions are thereby acquired.

The most interesting chapter in the book, however, is the one on Contrast of Colours; the examples are well chosen, and the coloured illustrations in the accompanying plates are in all cases convincing. The author shows with great success how little we may trust our own eyes as regards colour, and how difficult and even impossible it is to form a correct judgment of the relative darkness of two shaded fields, so long as they are not on the same ground.

The last chapter, which treats of the combination of colours, is necessarily the least complete; it shows, however, that the application of the theory to the arts has fairly begun. It has already been said that this beginning does not justify us in demanding from painters obedience to rules which have not been proved to be valid without exception. It may be easy to discover the application of these rules in acknowledged masterpieces, and yet be difficult to state them in such an exhaustive way that compliance with them will in all cases lead to perfect harmony. So long as this is not done it must not be expected that the painter will derive substantial help from the theory of colours. ARTHUR SCHUSTER

OUR BOOK SHELF

Illustrations of the Principal Natural Orders of the Vegetable Kingdom. Prepared for the Science and Art Department of the Council of Education. By Prof. Oliver, F.R.S., F.L.S. (London, Chapman and Hall, 1874.)

FEW books published of late years will be of greater practical value to the botanical teacher or student than this. The want has long been painfully felt of a work which will give in as few words as possible the salient characters of each of the more important natural orders, unencumbered by minutiæ of structure which concern only the more advanced student. This want we have here most admirably supplied, not only by 150 pages of text, but by upwards of 100 plates, which present in the most lucid form a representation (plain or coloured, as may be preferred) of a section and "diagram" of a flower belonging to many orders, together with a drawing of the fruit, seed, or other organ the structure of which is of special importance. The very comprehensive title of the work might, unless the contrary is pointed out, lead to a little disappointment, when it is found that the descriptions, and still more exclusively the plates, refer almost entirely to the more important *European* orders; very brief accounts, or in some cases none at all, being given of such remarkable extra-European groups as the Cycadeæ, Gnetaceæ, Proteaceæ, Bignoniaceæ, Piperaceæ, and others. As far as European botany is concerned, we cannot conceive that the work could have been better carried out. The plan which has been adopted of treating separately groups which are united together into a single order in our more advanced text-books—as for instance Fumariaceæ as distinct from Papaveraceæ; Oxalideæ and Tropæolaceæ from Geraniaceæ, and Droseraceæ from Saxifragaceæ—seems to us altogether commendable in a work designed especially for beginners. There has long been felt a desire that in text-books of botany the morphological and physiological portion should be divorced from the systematic and descriptive. We trust that in future this may be carried out, and that writers of text-books will confine themselves to the former branch, leaving the student to gain his elementary knowledge of the latter branch from special works like the one before us. A. W. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Photographic Irradiation

IN answer to Mr. Ranyard (NATURE, vol. x. p. 205), I have to state that the opaque bar in my experiments was placed as close to the collodion as possible without touching it, not farther than ·01 in. from it, and that there were no photographic traces of diffraction bands.

Allow me now to suggest a possible explanation of the different results given by Mr. Ranyard's and my own experiments. One important difference in the arrangement of the two experiments was, that in the one case the opaque bar was in contact with the collodion, and in the other case it was placed at a very short distance from it. In the experiments with the bar in contact with the collodion, the nitrate of silver solution on the surface of the plate would not form a true plane but would be curved upwards at the edge of the bar; and further, this curve would not be regular, but would have irregularities corresponding to every irregularity in the edge of the bar. This irregular curved fluid surface would cause irregular refraction of the light falling at the edge of the bar, and would give rise to bright and dark parts on the sensitive surface; the bright parts would be extended by molecular irradiation underneath the opaque bar, and would give rise to the irregular brushlike projections mentioned by Mr. Ranyard, instead of the uniform extension obtained when the bar is kept a short distance from the collodion. It is also possible that the irregular curved fluid surface may at certain points, where the bar was not in actual contact with the collodion, have bent the rays of light underneath the bar and given rise to the irregular extension of the image. JOHN AITKEN

Darroch, Falkirk, July 18

I MUST confess myself at issue with Mr. Stillman as to the result of his experiment with the strip of blackened wood laid upon the collodion film. I have tried a similar experiment, and find the images of bright objects sharply cut off. Even with a film of four thicknesses of collodion and an exposure of ten minutes, I cannot detect the smallest encroachment. The minute brushes mentioned by me in my last week's letter only occasionally occur, and appear to be due to a circulation in the liquid film beneath the opaque object, probably caused by some chemical impurity, for I notice that the brushes only occur when the film beneath the opaque object is soiled.

It cannot be argued that because there is a difference in the amount of irradiation in two pictures taken by different processes (instruments, exposures, and other conditions being similar), that therefore the spreading action must take place within the film, for the plates prepared by the two processes may not be equally sensitive, and the pictures may really correspond to what, with the same process, would be different amounts of exposure. Or again, the relative rates at which faint and intense light imprint themselves in the two processes may differ. Want of sensitiveness to the action of faint light is, I imagine, the reason why irradiation is apparently decreased by the use of the red collodion. A. COWPER RANYARD

Vapourising Metals by Electricity

IN a paper in NATURE (vol. x. p. 190) Mr. H. Hopkins gave a short description of some experiments on vapourising metals by electricity between two microscopic slides, and said that the layer thus produced can be investigated by a microscope, and employed in various ways to determine the character of the metal.

But the author did not point out the *wonderful drawings* shown by the layer, chiefly when a slight gold sheet is used.

This fact, very interesting in connection with molecular vibrations, has been illustrated by Prof. Magrini in a lecture delivered at the Museum of Florence, some years ago, and translated in *La Revue Scientifique* (t. iv. p. 770), with some woodcuts prepared by Prof. Magrini himself.

A. RODIER

Earth-shrinkings and Terrestrial Magnetism

IN my previous letter (vol. ix. p. 201) I gave some reasons for believing that the earth is shrinking chiefly about its equatorial region, and is being thrust out in the direction of the Poles, and that the distribution of this force may be correlated with that of terrestrial magnetism. As this view is somewhat novel and revolutionary, and if true will lead to considerable modification of the theories generally held on cosmical forces, I wish to support it by some other considerations.

I must predicate, as to a great extent proved, that volcanoes are not found in areas of upheaval. On this point I think the evidence is conclusive, and as I have previously written about it I shall not again enlarge upon it. I must predicate also that the earth as a whole is shrinking. This I tried to show in my previous letter. It follows from these facts that the large areas we know to be rising must be compensated by larger areas that are sinking, and that we may in a measure map these latter areas out by mapping out volcanoes; for, *ex hypothesi*, they occur either in areas of depression or along the border lines of the oscillating land.

Thus occurring, and themselves with the related phenomena of earthquakes, being the most vigorous proofs we have of the mobility of the earth's crust, we may predicate further that they will be found most actively at work where movements of the earth are most vigorously active, and that where they are liberally scattered, there the earth's crust is the most yielding. Now if we examine the distribution of volcanoes from this point of view we shall find that our main position is amply supported. Within the Arctic circle there is only one volcano, so far as we know—that of Jan Mayen. Within the Antarctic there is not one. North of the 60th degree of north latitude we have the volcanoes of Iceland, and three or four in Alaska, and these only. South of the 60th degree of south latitude we have Mount Erebus and its companions in the South Shetlands, and these only. Between the parallels of 40 and 60 the number of volcanoes increases considerably. In the northern hemisphere they probably number over sixty; but the vast majority of these are contained in the semicircular line of volcanoes formed by the Kurile and Aleutian Islands, and which crown that vast area of depression, the Pacific Ocean. In the southern hemisphere we still have exceedingly few, perhaps not more than a dozen, and these along the line of the Andes. It is in the region bounded on the north and south by the 40th parallels of latitude that we find volcanoes distributed in the greatest profusion, and the focus of distribution is even more narrow than this, for it may be bounded in fact by the 20th parallel on each side of the Equator. It is here we have that region described by so many writers in graphic terms, the Eastern Archipelago, with its 109 volcanoes in active operation. "From Papua to Sumatra, every large island," says M. Reclus, "including probably the almost unknown tracts of Borneo, is pierced with one or more volcanic outlets. There are Timor, Flores, Sumbawa, Lornbok, Bali, and Java, which last has no less than 45 volcanoes, 28 of which are in a state of activity, and lastly the beautiful island of Sumatra. Then to the east of Borneo, Ceram, Amboyna, Golola, the volcano of Ternata, sung by Camoens, Celebes, Mundanao, Mendora, and Luzon; these form across the sea, as it were, two great tracks of fire." (Reclus, "The Earth," 498.) Here also is that wonderful congeries of Pacific volcanoes described by the same graphic author. "The volcanoes of Abrim and Tauna, in the New Hebrides, Turahoro, in the Archipelago of Santa Cruz, and Semoya in the Salomon Islands, succeeding one after the other, connect the knot of the Feejees to the region of the Sunda Islands, where the earth is so often agitated by violent shocks. This region may be considered as the great focus of the lava-streams of our planet." It is within the same narrow limits also that we have the most active signs of movement in the Atlantic basin, namely, in the Little Antilles group of the West India Islands. In regard to the two regions last mentioned, there is a fact remarkably confirming the general position I argued in favour of in a previous letter, namely, that volcanoes are indicative of areas of depression, and which was unknown to me when I wrote it. M. Reclus says—"It is a remarkable fact that the two volcanic groups of the Antilles and the Sunda Islands are situated exactly at the Antipodes one of the other, and *also in vicinity of the two poles of flattening, the existence of which on the surface of the globe has been proved by the recent calculations of astronomers.* (Op. cit., p. 503.)

These facts seem to me to support very strongly my contention that the earth is shrinking chiefly in its equatorial region. Volcanoes are in my view the mediate and not the immediate results of the shrinking of the earth; earthquakes on the contrary are its immediate result. There is considerable difficulty in mapping out a chart of their frequency and intensity, but we may say safely that such a chart would have a deeply-coloured zone in the equatorial regions, that it is there where earthquakes and especially submarine earthquakes chiefly abound, and abound also in their more vigorous type. This can only be if that area is also the chief area of disturbance of the earth's crust. Another fact which points in the same direction is that discussed by Bischof, namely, that the soundings in the greater oceans increase as we near the equator, this increase taking place relatively to the land masses and not being merely due to the bulging out of the water in those parts by the force of attraction. So that if we accept the level of Africa or the Pampas of Brazil as a mean we shall find the greatest pits and hollows in the crust in the equatorial region.

In regard to the connection of this earth-shrinking with terrestrial magnetism, I wish to quote one or two paragraphs from Dr. Zollner's paper in the "Philosophical Magazine" on the origin of the earth's magnetism, to the conclusions of which, however, I cannot in any way assent. I quote him on the subject of the correlation of earthquakes with magnetic disturbances. He is quoting from Mr. Lamont's work.

"Kreil has given many cases," he says," where magnetic disturbances coincided with earthquakes; hence he thinks—cornection between the two phenomena probable. I have observed myself an extremely curious case in this respect on April 18, 1842; at 9.10 A.M., I saw by chance that the needle of the declination instrument received a sudden jerk so that the scale was pushed out of the field of view of the telescope. The oscillations continued for some time; at last the ordinary tranquillity was restored. After some days I received the news from Colla, in Parma, that he had observed violent oscillations of the needle, and comparisons showed that the movement had begun at the same moment in Parma as in Munich. A short time after, the report of a French engineer was published, on a violent earthquake which he had observed in Greece; and now it was found that the earthquake had taken place in the same minute in which the oscillations of the needle had been observed in Parma and Munich. This together with the many cases collected by Kreil and Colla, leaves scarcely any doubt as to the presence of a close connection; but it is undecided whether one phenomenon is the consequence of the other, or whether they both come from the same source. The same connection between earthquakes and magnetic disturbances was observed by Lamont at the earthquake which took place in Greece in December 1861. He communicates his observations to *Poggendorff's Annalen* (vol. cxv. 176) in the following words: "As the connection of the magnetism of the earth with earthquakes still belongs to the insufficiently ascertained relatives, it will not appear irrelevant if I communicate a fact bearing upon this question. On December 26, 1861, at 8 o'clock A.M., when I took down the position of the magnetical instruments (some of which are put up in the magnetical observatory, viz. two for declination, two for intensity, and two for dip), I observed in all the instruments an uncommon restlessness, consisting in a quick and irregular decrease and increase in the declination, and at the same time a trembling in the vertical direction. The trembling of the needle only lasted for a short time, but the quick changes lasted until 8.30 o'clock with gradually increasing violence. Some days later the news was received of an earthquake which, exactly coincident with the above observations, had caused great destruction in many parts of Greece." (Philosophical Magazine, June 1872.) This goes far to show that terrestrial magnetism it to be correlated with the force which is shrinking the earth. HENRY H. HOWORTH

COLLIERY EXPLOSIONS

It is astonishing that, notwithstanding the many generations during which coal-mining has been carried on in this country, so comparatively little has been done to investigate scientifically the causes of explosions in coal-mines, and thereby discover an antidote to a constantly recurring danger, one which adds considerably to the yearly bills of mortality, and still more to the number of widows and orphans. No doubt a considerable proportion of these sad accidents is owing to the carelessness of miners themselves, but very many are, without doubt, also due to ignorance, on the part of all concerned, of the conditions under which coal-mining must be carried on. Only the other day a melancholy tale of death and widespread mourning comes from Wigan—fifteen men killed, leaving behind them at least thirty-one persons destitute of the means of gaining a livelihood. We are afraid that the frequency of such accidents has made the public somewhat callous in the matter; but a little consideration must show the vast importance of acquiring a thorough knowledge of the conditions under which they may happen. To this end the paper recently read before the Royal Society by Mr. William Galloway, Inspector of Mines, is an important contribution; and we hope that the author and others who are competent will continue their investigations until, if explosions cannot be prevented, they may at least be foreseen and provided against.

The opinions promulgated by Sir Humphry Davy and the eminent Colliery Viewers who were his contemporaries, regarding the security afforded by the use of the safety-lamp, have been accepted with hesitation by many of their successors during the last twenty or thirty years; and this is not to be wondered at when we consider the large number of disastrous explosions by which thousands of lives have been lost in mines in which these lamps were in constant use. The illustrious inventor himself had discovered and pointed out, that if the lamp were exposed to the action of an explosive current, the flame might pass through the meshes of the wire-gauze and so originate an explosion; but when in good order it was considered to be safe under all other circumstances, until the experiments were made which form the subject of Mr. Galloway's paper.

At first, and for many years after the introduction of the safety-lamp, the cause of nearly every explosion was attributed to carelessness on the part of the workmen using it; then it was observed that a quantity of firedamp, sufficient to render some of the air-currents explosive, was sometimes suddenly given off by the strata, and these "outbursts of gas," as they are called, were assumed, in the absence of any other explanation, to have caused many explosions. On Dec. 12, 1866, however, the great explosion took place at the Oaks Colliery; as it was known to have happened simultaneously with the firing of a heavily-charged shot in pure air attention was drawn to the coincidence; and it appears that some search has usually been made for evidence of recent shot-firing in mines in which explosions have occurred since that date. Accordingly we find from the reports of the Inspectors of Mines that shot-firing was carried on in seventeen out of twenty-two collieries, at which important explosions have happened since Dec. 12, 1866; safety-lamps were certainly used in twelve of these collieries, and probably in the whole seventeen; in eight cases it was ascertained that a shot had blown out the tamping at or about the time of the explosion; in two an empty shot-hole was found from which it was supposed the tamping had been blown; in three a shot had been fired, bringing down the coal or rock; lastly, there were five collieries at which two or more explosions took place simultaneously, in different parts of the mine unconnected by a train of explosive gas. The Seaham explosion was a remarkable one; a heavily charged shot was fired in pure air in one of the in-take air-courses, and, according to the statement of three men who survived, the explosion of firedamp followed the shot immediately.

Two methods of accounting for the simultaneousness of the explosion of firedamp with the firing of the shot have been suggested in the reports of the Inspectors of Mines: one of them supposes that the firedamp has been ignited directly by the shot; the other that the concussion of the air caused by the explosion of gunpowder dislodges gas from cavities in the roof and from grooves, and that this gas passing along in the air-currents is ignited at the lamps of the workmen. In some instances when it has been known to be highly improbable that any gas existed nearer to the shot-hole than 10, 20, or even 40 ft., the advocates of the former hypothesis have taken it for granted that the gases issuing from the shot-hole were projected through the air as far as the accumulation of firedamp, retaining a sufficiently high temperature to ignite it on their arrival. On the other hand the advocates of the latter hypothesis have not attempted to show how the gas, which they assumed could be dislodged in quantity by a sound-wave and its reflections, could be ignited in those cases in which safety-lamps only were used. It is no doubt highly probable, however, that when once an explosion of firedamp has been initiated in one way or another, and large bodies of air are driven through the passages of a mine with great velocity, explosive accumulations will be dislodged from cavities and grooves and pressed through the safety-lamps with the velocity requisite to pass the flame.

In the beginning of the year 1872 Mr. Galloway first thought it probable that a sound-wave originated by a blown-out shot, in passing through a safety-lamp burning in an explosive mixture, would carry the flame through the meshes of the wire-gauze in virtue of the vibration of the molecules of the explosive gas. An explosion which took place at Cethin Colliery in 1865 is a good example of one that may have been caused in this way. Several days after the explosion the safety-lamp of the overman was found securely locked and uninjured, lying at a distance of a few yards within an abandoned stall which was known to have contained firedamp. Shot-firing was carried on in this mine, and it is not improbable that a sound-wave from an overcharged or blown-out shot had passed through this lamp and ignited the explosive mixture shortly after the overman had entered it; moreover, the Inspector of Mines in his report says he has no doubt that the gas in this state was ignited and was therefore the origin of the explosion, but he is unable to state by what means it was fired.

A number of experiments were made by Mr. Galloway in connection with this subject; the cost of apparatus, &c., was provided for by the liberality of the Government Grant Committee of the Royal Society.

The first experiment was made on Jan. 16, 1872, in the physical laboratory of University College, London. A sheet of wire-gauze 1 ft. square was inclined at an angle of 70° and a slow current of gas and air from a Bunsen-burner was directed against its lower surface; part of the explosive mixture passed through the meshes, and when ignited produced a flat flame 3 in. long by 1 in. wide about the middle of the upper surface of the wire-gauze. A glass tube 3 ft. 4 in. long by about 3½ in. diameter was placed horizontally with one end opposite to the flame on the same side of the wire-gauze and distant from it about 1½ in. At the other end of this tube a sound-wave was produced by the explosion of a mixture of coal-gas and oxygen contained in soap-bubbles. When the sound-wave passed through the tube the flame was carried through the meshes of the wire-gauze and ignited the gas issuing from the Bunsen-burner on the other side.

Some experiments similar to the first were made in one of the laboratories of the Royal College of Chemistry in Dec. 1872. The glass tube was replaced by a tin-plate tube about 20 ft. long by 2 in. diameter: paper and other diaphragms were inserted at a distance of 10 ft. from the origin of disturbance to insure that only a sound-wave was propagated through the tube. The results were the same as before.

Two sets of apparatus, a larger and a smaller, were then constructed; in both the sound-wave of a pistol-shot is conveyed through tin-plate tubes to a distance of about 20 ft., then it passes through a safety-lamp burning in an explosive mixture. In the smaller apparatus the tube is 3 in. in diameter; one end is closed by a disc of wood with a hole in the middle large enough to receive the muzzle of a pistol; at a distance of 10 ft. from the disc there is a diaphragm of sheet india-rubber, and at the farther end is a safety-lamp with gas-flame. At the bottom of the safety-lamp there is a circular chamber with holes round about from which gas can be made to escape, and when this gas, rising up, mixes with the air it forms an explosive mixture surrounding the wire-gauze cylinder. The pistol by means of which the sound-wave is produced is charged with ·205 gramme of gunpowder, and a tamping paper is rammed down well upon the charge. When the shot is fired through the hole in the wooden disc, while the explosive mixture surrounds the lighted safety-lamp, the flame is instantly carried through the meshes by the vibration, and ignites the gas on the outside. In the larger apparatus the tube is 8 in. in diameter, and 21 ft. long; at one end there is a wooden disc as before; at 20 ft. from the disc there is a sheet india-rubber diaphragm, and the extreme end is closed by a sheet of thin paper tied over it. Part of the last 12 in. (thus isolated from the rest of the tube and from the exterior) is enlarged sufficiently to hold a safety-lamp, and it is provided with an inlet below for air or air and gas, and a chimney above for the sake of the products of combustion. A lighted Davy or Clanny lamp of ordinary construction having been placed in this space, gas is made to mix with the air which flows up through it in consequence of the draught caused by the lamp: the appearances presented by the flame are observed through a small glass window, and when they indicate that the air is explosive the shot is fired. The flame within the safety-lamp is passed through the meshes, explodes the mixture in the isolated space, blowing out the paper end, and, passing backwards through the inlet, ignites the gas where it first mixes with air. In this case the shot consists of ·41 gramme of gunpowder tamped as before.

The lamps that were tested in this apparatus are those known as the Davy, Clanny, Stephenson, Mueseler, and Eloin. The flame was easily passed through the Davy lamp, with rather more difficulty through the Clanny, and not at all through any of the others.

The first experiments with these two sets of apparatus were made in January and February 1873, at the Meteorological Office, where Mr. Scott most kindly provided accommodation: the experiment with the smaller apparatus was shown at the Royal Institution, by Mr. Spottiswoode, on the evening of Jan. 17; and afterwards at one of the Cantor Lectures of the Society of Arts, by the Rev. Arthur Rigg. The next experiments were made in No. 7 Pit, Barleith, near Glasgow, with firedamp from a blower, but the flame could not be passed through the safety-lamps on account of the impurity of the gas, which contained only 75·86 of light carburetted hydrogen. The last experiments were made in the C Pit of Hebburn Colliery, near Newcastle-on-Tyne, also with firedamp from a blower, and as the firedamp was very explosive, the flame was easily passed through the Davy-lamps of each apparatus.

After this, experiments were made on a larger scale in part of a new sewer in North Woodside Road, Glasgow. The sewer is ovoid in section; it is 6 ft. high and 4 ft. wide at its greatest dimensions; part of it is a tunnel in the solid rock, part is built in brickwork through surface-drift. The gas safety-lamp of the smaller apparatus was placed on a board fixed across the sewer at a height of 2 ft. 8 in. from the bottom, and surrounded with an explosive mixture of coal-gas and air in the same way as when it was used in connection with the tin-plate tubes. Shots were fired from a pistol at certain distances from the lamp (the details of the distances and the charges required to pass the flame in the paper and sections of the sewer are given in the plates which accompany it). One hundred and nine feet was the greatest distance available in the part built of brick, and at this point a sound-wave of sufficient intensity to pass the flame was produced by firing a charge of 3·882 grammes = 59 grains of gunpowder. At 96 ft. from the lamp a charge of 3·276 grammes was required when the sound-wave passed through the brickwork tunnel all the way, and 2·184 grammes when it passed through the tunnel in the solid rock. These experiments seem to be perfectly conclusive.

Mr. Galloway's discovery—that when the vibration of the air which constitutes a sound-wave has a certain amplitude, it can transmit flame through the wire-gauze of the Davy and Clanny lamps—furnishes an additional argument against retaining these lamps in use, at least in the hands of ordinary workmen. On Dec. 15, 1815, Davy said he was convinced that, as far as ventilation was concerned, the resources of modern science had been fully employed; he then proceeded to describe a "safety lantern," which is identical in principle with the Stephenson lamp, and is extinguished in an explosive mixture (Phil. Trans. 1816, p. 2). This "safety lantern" was afterwards discarded in favour of the Davy lamp proper, the principal advantage of which was stated to be that it would not only preserve the collier from the firedamp, but enable him to apply it to use, and destroy it at the same time that it gave him a useful light (Phil. Trans. 1816, pp. 23 and 24). Fortunately the ventilation of mines is now better understood than it was in the days of Davy, and the quantities of air employed are usually very much greater. It is certain, however, that in some mines of the present day the ventilation could be doubled or trebled with advantage; and since this is merely a matter of expense it may be asked why it is not done, when it would ensure comparative immunity from danger? On the other hand it is now almost universally admitted to be highly dangerous to continue work in an explosive atmosphere, so that safety-lamps should be used only as a precaution against possible outbursts of gas or when work is carried on in the neighbourhood of gas that cannot be easily dislodged; it is evident, therefore, *primâ facie*, that lamps constructed on the principle of the "safety-lantern," such as the Stephenson, Mueseler, &c., which are extinguished in an explosive mixture, are far safer than lamps like the Davy or Clanny, which continue to burn under the same circumstances, and are then liable, at any instant, to have the flame driven through the wire gauze and communicated to the external explosive atmosphere.

THE COMET

[The following letter appeared in last Thursday's *Times*, from the columns of which journal it is reproduced, with a few verbal alterations.]

I WAS enabled on Sunday night (12th inst.), by Mr. Newall's kindness, to spend several hours in examining the beautiful comet which is now visiting us, by means of his monster telescope—a refractor of 25 in. aperture, which may safely be pronounced the finest telescope in the world, or, at all events, in the Old World.

The view of the comet which I obtained utterly exceeded my expectations, although I confess they were by no means moderate; and as some of the points suggested by the observations are, I think, new, and throw light upon many recorded facts, I beg a small portion of space in the *Times* to refer to them, as it is important that observers should have their attention called to them before the comet leaves us.

I will first deal with the telescopic view of the comet. Perhaps I can give the best idea of the appearance of the bright head in Mr. Newall's telescope, with a low power, by asking the reader to imagine a lady's fan opened out (160°) until each side is almost a prolongation of the other. An object resembling this is the first thing that strikes the eye, and the nucleus, marvellously small and definite, is situated a little to the left of the pin of the fan—not exactly, that is, at the point held in the hand. The nucleus is, of course, brighter than the fan.

Now, if this comet, outside the circular outline of the fan, offered indications of other similar concentric circular outlines, astronomers would have recognised in it a great similarity to Donati's beautiful comet of 1858 with its "concentric envelopes." But it does not do so. The envelopes are there undoubtedly, but, instead of being concentric, they are excentric, and this is the point to which I am anxious to draw attention, and, at the risk of being tedious, I must endeavour to give an idea of the appearance presented by these excentric envelopes. Still referring to the fan, imagine a circle to be struck from the left-hand corner with the right-hand corner as a centre, and make the arc a little longer than the arc of the fan. Do the same with the right-hand corner. Then with a gentle curve connect the end of each arc with a point in the arc of the fan half-way between the centre and the nearest corner. If these complicated operations have been properly performed the reader will have superadded to the fan two ear-like things, one on each side. Such "ears," as we may for convenience call them, are to be observed in the comet, and they at times are but little dimmer than the fan.

At first it looked as if these ears were the parts of the head furthest from the nucleus along the comet's axis, but careful scrutiny revealed, still in advance, a cloudy mass, the outer surface of which was regularly curved, convex side outwards, while the contour of the inner surface exactly fitted the outer outline of the ears and the intervening depression. This mass is at times so faint as to be invisible, but at other times it is brighter than all the other details of the comet which remain to be described, now that I have sketched the groundwork. These details consist of prolongations of all the curves I have referred to backwards into the tail.

Thus, behind the bright nucleus is a region of darkness (a black fan with its pin near the pin of the other pendant from it, and opened out 45° or 60° only will represent this), the left-hand boundary of which is a continuation of the lower curve of the right ear. The right-hand boundary is similarly a continuation of the lower curve of the left ear. Indeed, I may say generally—not to enter into too minute description in this place—that all the boundaries of the several different shells which show themselves, not in the head in front of the fan, but in the root of the tail behind the nucleus, are continuous in this way—the boundary of an interior shell on one side of the axis bends over in the head to form the boundary of an exterior shell on the other side of the axis.

At last, then, I have finished my poor and, I fear, tiresome description of the magnificent and truly wonderful sight presented to me as it was observed, on the whole, during some hours' close scrutiny under exceptional atmospheric conditions.

I next draw attention to the kind of change observed. To speak in the most general terms, any great change in one "ear" was counterbalanced by a change of an opposite character in the other; so that when one ear thinned or elongated, the other widened; when one was dim, the other was bright; when one was more "pricked" than usual, the other at times appeared to lie more along the curve of the fan and to form part of it. Another kind of change was in the fan itself, especially in the regularity of its curved outline and in the manner in which the straight sides of it were obliterated altogether by light, as it were, streaming down into the tail.

The only constant feature in the comet was the exquisitely soft darkness of the region extending for some little distance behind the nucleus. Further behind, where the envelopes of the tail were less marked, the delicate veil which was over even the darkest portion became less delicate, and all the features were merged into a mere luminous haze. Here all structure, if it existed, was non-recognisable, in striking contrast with the region round and immediately behind the fan.

Next it has to be borne in mind that the telescopic object is after all only a section, from which the true figure has to be built up, and it is when this is attempted that the unique character of this comet becomes apparent. There are no jets, there are no concentric envelopes; but, as I have said, in place of the latter, excentric envelopes indicated by the ears and their strange backward curvings, and possibly also by the fan itself.[*]

I prefer rather to lay the facts before observers than to state the conclusions to be derived from them, but I cannot help remarking that, supposing the comet to be a meteor-whirl, the greatest brilliancy is observable where the whirls cut or appear to cut each other; where we should have the greatest number of particles, of whatever nature they may be, in the line of sight; and not only so, but regions of greatest possible number of collisions associated with greatest luminosity.

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[*] By describing three parabolas on a card and spinning the card rapidly round a line not coincident with their common axis, I have been able to reproduce roughly the appearances figured last week and described above. —J. N. L.

It would be a comfort if the comet, to partly untie a hard knot for us, would divide itself as Biela's did. Then, I think, the whirl idea would be considerably strengthened. I could not help contemplating the possibility of this when the meaning of the "ears" first forced itself upon my attention.

The spectroscopic observations which I attempted, after the telescopic scrutiny, brought into strong relief the littleness of the planet on which we dwell, for a seven hours' rail journey from London had sufficed to bring me to a latitude in which the twilight at midnight was strong enough to show the middle part of the spectrum of the sky, while to the naked eye the tail of the comet was not so long as I saw it in London a week ago.

I had already in observations in my own observatory, with my 6¼ in. refractor (an instrument smaller than one of Mr. Newall's four finders!) obtained indications that the blue rays were singularly deficient in the continuous spectrum of the nucleus of the comet, and in a communication to NATURE I had suggested that this fact would appear to indicate a low temperature.

This conclusion has been strengthened by Sunday night's observations, and it was the chief point to which I directed my attention. The reasoning on which such a conclusion is based is very simple. If a poker be heated, the hotter it gets the more do the more refrangible—*i.e.* the blue—rays make their appearance if its spectrum be examined. The red colour of a merely red-hot poker and the yellow colour of a candle-flame are due, the former to an entire, the latter to a partial, absence of the blue rays. The colour, both of the nucleus and of the head of the comet, as observed in the telescope, was a distinct orange yellow, and this, of course, lends confirmation to the view expressed above.

The fan also gave a continuous spectrum but little inferior in brilliancy to that of the nucleus itself; while over these, and even the dark space behind the nucleus, were to be seen the spectrum of bands which indicates the presence of a rare vapour of some kind, while the continuous spectrum of the nucleus and fan, less precise in its indications, may be referred either to the presence of denser vapour, or even of solid particles.

I found that the mixture of continuous band spectrum in different parts was very unequal, and further that the continuous spectrum changed its character and position. Over some regions it was limited almost to the region between the less refrangible bands.

It is more than possible, I think, that the cometary spectrum, therefore, is not so simple as it has been supposed to be, and that the evidence in favour of mixed vapours is not to be neglected. This, fortunately, is a question on which I think much light can be thrown by laboratory experiments.

J. NORMAN LOCKYER

Mr. Newall's Observatory, Ferndene, Gateshead

P.S.—(By Telegraph.)—Wednesday night.—Sunday's observations are confirmed. The cometary nucleus is now throwing off an ear-like fan. Ten minutes' exposure of a photographic plate gave no impression of the comet, while two minutes' gave results for the faintest of seven stars in the Great Bear.

THE FORMS OF COMETS[*]

I.

A FEW years ago astronomers studied comets almost solely to determine their movements. So little advance had been made in the study of the figures of these bodies, that M. Arago believed himself justified in stating in his "Astronomie populaire:"—"'I don't know' will still be the reply we have to make to questions asked concerning the tails of comets." If I venture to take as the principal subject of this lecture the researches which I have undertaken during recent years in this difficult subject, I hope to disarm criticism beforehand by at once declaring that the results contrast singularly, by their imperfection, with the degree of power and of certainty we admire in the other more ancient branches of astronomy.

The reason of this contrast is very simple. While planetary astronomy received the precious heritage of the science of the Greeks and the treasury of observations bequeathed by the highest antiquity, cometary astronomy finds in the archives of history observations travestied by superstitious terror. One of the strongest prejudices of previous centuries was that which attributed to the stars a mysterious influence on our destinies. And comets, by their unforeseen appearance in the midst of the familiar constellations, their monstrous heads, their gigantic tails, were calculated to inspire a sort of apprehension which judicial astrology, that long infirmity of the human mind, did not fail to interpret as menacing presages; and as catastrophes have not been wanting in every period of our history, the singular sophism, *post hoc, ergo propter hoc*, so natural to our poor logic, helped to confirm ten or twelve times in a century this miserable superstition.

Did a comet appear in the heavens, morning or evening, the astrologer had to be consulted. He did not go to work without rules; he had a complete classification of strange forms under which these heavenly bodies already had been observed, and to each form was attached a particular signification. Pliny has preserved this nomenclature for us: Hevelius, the learned *pensionnaire* of Louis XIV., faithfully reproduced it in the middle of the 17th century, in the fantastic figures of his *Cometographia*. And, certainly, everything was taken in the most literal manner: in a comet with a crooked, or straight, or multiple tail they traced, such is the power of imagination, a gigantic sabre, a lance, or a fiery bolt, a burning torch or a dragon hurling upon an entire country the plague, rebellion or famine. Figs. 1 and 2 are indications of this idea taken from the "Theatricum cometicum" of Lubienitzki. The first comet, in the form of a blazing torch, indicates very clearly by the direction of its tail the flames which will consume the neighbouring town; the second, a veritable dragon, whose tortuous folds the artist has reproduced, threatens France and Ireland from the seven points of its tongue of fire.

These specimens will suffice; there is no use in producing similar statements and similar pictures; at the most we can barely find here and there in the theories which were then formed some traces of the truth.

Astrology thus stifled real observation until the beginning of the seventeenth century. This may now appear strange to us, but there is no doubt of it. The astronomers of those times, so near in time to ourselves, and already so bold with the universal *renaissance* of the human mind, were almost all to some extent astrologers. Kepler himself, one of the glorious fathers of modern astronomy, was obliged by the duties of his office as Imperial Astronomer both to draw the horoscope of the war of the Pope against Venice, and to give to his powerful but too-straitened patron, the Emperor Rodolph II., an opinion on the comet of 1607, which appeared to be menacing Hungary Besides, Rodolph counted much then upon his alchemist to find the gold necessary to pay his army; while his general, the Duke of Friedland, the celebrated Wallenstein, never failed to consult the heavens, always by the help of Kepler, who has preserved for us his horoscope.

But already, from the time of Tycho Brahé, astronomy had commenced to place a hesitating foot in the domain of comets, from which she was soon to drive astrology. Until then men had lived, upon the faith of

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[*] A lecture by M. Faye delivered at the "Soirées Scientifiques de la Sorbonne." Translated from *La Revue Scientifique*.

Aristotle, in the thought that comets were not celestial bodies, but mere sublunary meteors; and now it was discovered, by substituting observation for the word of the master, that they journeyed far above the orbits of Mercury and Venus, without being in the least incommoded by the crystalline spheres of the firmament in which the old astronomy incrusted its planets and stars. From the time of Newton comets were at last embraced, so far as the movement of the nucleus was concerned, in the theory of attraction, and consequently in planetary astronomy, with this single difference, that they described around the sun ellipses enormously elongated, almost parabolic, instead of ellipses almost circular, like the planets. Then astronomers observed carefully the successive positions of these nuclei, and calculated their orbits, but without attending to the figure of the comets themselves, although the invention of the telescope must have already revealed a number of curious phenomena which escaped the naked eye. During this period astronomers restricted themselves to representing the comet by a small circle, the centre of which alone was of importance, for there was the centre of gravity to which the laws of Kepler applied, and the calculation of the elements of the orbit. As to the tail, which attracted no attention, they figured it very simply by some feathery traces attached to the nucleus. In all this there is nothing to attract attention now, any more than the dragons of the astrologers. It was no longer now a superstitious prejudice which took from astronomers the desire to closely examine the facts; it was a preconceived idea, an elevated idea, no doubt, but too absolute, according to which the only force to be regarded in the celestial spaces was attraction. At bottom it was vaguely felt that the figures of comets were irreconcilable with this ruling hypothesis; and this was sufficient, for the eye was brought to bear by preference upon the subject the most attainable by the reigning theories.

FIG. 1.

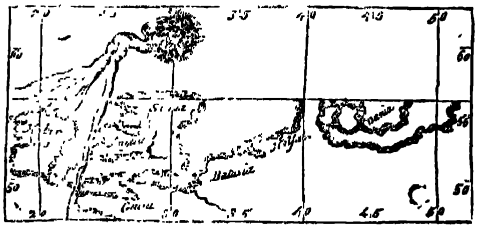


FIG. 2.

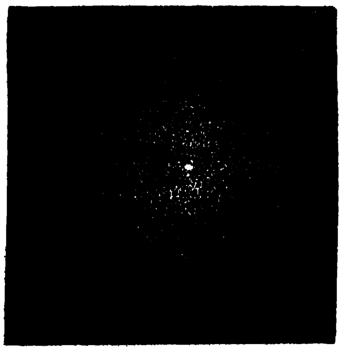


FIG. 3.

Leaving aside the rude drawings of the six-tailed comet of 1744, by Chézeaux, and those which Messier made by rule and compass, we must come down to the two Herschels before we find trustworthy observations on the form of comets; the beautiful drawings of the comets of 1811 and 1835 are even now of use to science. Astronomers had at last learned, from the example of Olbers and Bessel, the high importance of these phenomena, which reveal to us more than a new world, since they tell us of a new force in the universe. At present the figure of comets has become the subject of the most earnest research, and the drawings of the beautiful comet of Donati (1858) which I am about to show you will give you an idea of the change which, in this respect, has taken place in the minds of astronomers. I can confidently vouch for their fidelity, for, while Bond was executing these drawings at the Cambridge (U.S.) Observatory, by means of a telescope of great power, I followed the same body at Paris with the first telescope which Foucault constructed on his new system, and it appears to me while looking with you on these drawings of Bond, as if I still had that wonderful comet before my eyes.

I shall endeavour first to give an exact idea of the successive metamorphoses which comets present during the course of their appearance, taking as a type a comet which has been perfectly studied—that of Donati. Let us remember that these bodies describe around the sun ellipses extremely elongated, of which the sun occupies the focus; that the point nearest the sun is called the *perihelion*, while the most distant point (in a truly parabolic orbit this would be infinite) is called the *aphelion*. Unlike the planets, which describe orbits almost circular, and remain always at nearly the same distance from the sun, comets, in general, come to us from regions much more distant than the most remote planets; but they only become visible, even to the telescope, in the part of their orbit which is nearest to the sun. After their passage at perihelion, their distance from the sun becomes greater and greater, and soon they cease to be visible. I do not believe that any comet has been seen beyond the orbit of Jupiter. It is assuredly not on account of their smallness that they thus escape our notice in regions where the most distant planets, Saturn, Uranus, and Neptune, shine so clearly with the light which they borrow from the sun; this is because the rare and nebulous matter of comets reflect much less light than the solid and compact surface of the planets of which we speak, much less even than the smallest cloud of our atmosphere.

When they are seen far from the sun through a telescope, they appear like rounded nebulosities, but vaguely defined, presenting at the centre a condensation sufficiently marked, which is called the *nucleus*; it is this nucleus, more brilliant than any other part, whose position astronomers observe. Fig. 3, representing Donati's comet at the time of its discovery, June 5, 1858, gives a sufficient idea of the aspects of all comets when they are at a great distance from the sun.

At a later period, when the comet is approaching its perihelion, it sensibly lengthens out in the direction of the radius vector, *i.e.* in the direction of an imaginary line which would join the comet and the sun; but then the bright nucleus is no longer found in the centre of the figure, but is situated excentrically on the side nearest to the sun, as is shown in Fig. 4.

Later still, the tail is formed, and is developed more and more, like an opened fan, while the nucleus shines with a more vivid brightness. The comet becomes visible to the naked eye as in Fig. 5.

This tail is always away from the sun. At its origin, near the nucleus, it lies in the prolongation of the radius vector; at a greater distance it is curved backwards, as if it met with some resistance which hindered it from following completely the path of the nucleus. The bent axis of this tail is, however, always situated in the plane of the orbit, and this simple fact accounts for the many varieties of aspect presented to our eyes by these cometary appendages. Comets with straight tails appear such only because the eye of the observer is in the plane of the axis of the tail, *i.e.* in the plane of the orbit. When the earth, in consequence of its annual motion, is carried from this plane, the curvature of the tail becomes manifest; it becomes more and more pronounced as the comet, seen at first edgeways, so to speak, shows itself more and more on the flat, like a scimitar, to the observer.

When the comet, describing the descending branch of its orbit, reaches perihelion, these phenomena acquire their full development. But when it recedes from the sun, describing the ascending branch of its immense parabolic trajectory, the tail diminishes, disappears, and gives place to a mere elongation. Soon it again assumes the spherical form; the nucleus, which has gradually lost its brightness, is indicated only by a slight condensation of light at the centre of a globular mass entirely similar to that which was first seen. Finally this rounded nebulosity disappears.

Upon what scale do these phenomena take place, the immediate cause of which is evidently located in the sun? What may be the dimensions of these nebulosities, of these brilliant nuclei, of these curved tails? These dimensions are assuredly formidable. The comet of 1843 had a tail of 60,000,000 leagues, nearly double our distance from the sun. On the sky that tail was drawn like an immense dash of a brush of 65 degrees of angular amplitude. The tail of the famous comet of 1811 was only 40,000,000 leagues: but, on the other hand, the head alone of the comet (250,000 leagues in diameter) was nearly as large as the sun.

As to Donati's comet, its dimensions were more modest; its nucleus was 1,000 leagues in diameter, and the head only about 13,000; the tail was only about 14,000,000 leagues in length. I had the curiosity to estimate approximately the volume of this small comet, and I found, supposing that the thickness of the tail is equal to its breadth, its volume was a thousand times greater than that of the sun. As in reality the tails are flattened, it will perhaps be necessary to reduce this figure by half. There remains enough to show us that our terrestrial globe, so little beside the sun, is only a point in comparison with these gigantic bodies.

But, on the other hand, everything proves to us that these bodies contain very little matter in so enormous a volume. A characteristic which is special to them, and which assuredly belongs neither to the planets nor to their satellites, is their almost absolute transparency. The stars are seen through the tail of a comet as if the tail did not exist; they can be seen even through the head, much more dense and more brilliant than the tail. It was for long a question whether the nucleus, at least, of a comet would not be opaque and solid like a planet; but, after examination by the most powerful telescopes, it has always been found to be formed of nebulous layers, more and more dense, always permeable by rays of light. This very simple and altogether characteristic fact leads us, by itself, to think that cometary matter must be of extreme rarity, for a mist of some thousands or even of some hundreds of metres in thickness suffices to hide the stars, while a thickness of from 10,000 to 15,000 leagues of cometary matter scarcely lessens their lustre. Desiring to fix our ideas on this subject, I calculated the mass of Donati's comet, and found that it equalled at least that of a sea of 100 metres in depth, and 16,000 square leagues of superficies. This mass is only a fraction, almost imperceptible, of that of the earth. It was almost entirely concentrated in the head of the comet and around in the nucleus; even supposing it uniformly distributed over the whole volume of the tail, there will be found, for the mean density of that appendage, only a value incomparably more feeble than the density of the void approached by our pneumatic machines. But it is not to this rare gaseous residue that we must compare the matter of comets; it will resemble rather those impalpable grains of dust which dance in the air, and which are disclosed to us by the smallest ray of solar light penetrating a darkened chamber.

Fig. 4.

Although comets show us matter rarefied to such an extent that a celebrated physicist, M. Babinet, could with considerable justness call them "visible nothings" (*riens visibles*), do not, however, imagine that their contact with our earth would be without inconvenience. If the nucleus of our comet had directly encountered the earth, with its mass of 25,600 millions of millions of kilogrammes, and its relative speed of seventeen leagues per second (seven for the earth and ten in an opposite direction, for this retrograde comet), the actual energy of the shock would be enormous; I calculated that its transformation into heat would immediately generate fifty-one million *calories* per square metre of the hemisphere which sustained the shock. It would be enough to shatter, dissolve, and volatilise a part of the solid crust of our globe. No living being could survive such a catastrophe. Happily the probability of such an encounter is excessively small; and, indeed, the most remote geological ages do not bear any traces of such an adventure. We cannot, however, forget that meteors and shooting stars, perhaps even the aerolites which bombard us so regularly every year and every day of the year, have probably the same origin as comets, and result from a mass of analogous materials which are decomposed in penetrating our solar world.

Fig. 5.

(*To be continued.*)

THE FLYING MAN

THE fatal experiment made by M. de Groof at Cremorne Gardens could not possibly have led to success. The possibility of directing an apparatus in the air by any mechanical contrivance, without actually using the lifting power of gas, is out of the question, and we do not wish to enter into a discussion on that point. But several interesting problems may be examined *à propos* of the inquest held by the coroner on the death of the unfortunate man.

De Groof's wings, irrespective of their motive power, may be regarded as two imperfect parachutes intended to diminish his rate of falling, and, if kept horizontal, prevent it increasing above a certain rate. It remains to see if their surface was large enough to keep that velocity within reasonable limits. The wings of De Groof were 30 ft. by 4 ft.; but being irregularly shaped, we may suppose the surface of each was 100 sq. ft., or in round numbers 200 sq. ft. for the two. The weight of the machine not being far from 4 cwt. if we include the man, we may say in gross numbers that each square foot had a kilogramme to support, which is more than ordinary; the parachute maker taking 1 kilogramme for each square metre, which is about ten times smaller.

But to ascertain if the velocity, although being larger than under ordinary circumstances, was really dangerous we must go to the formulæ established by General Didion and quoted by Poucelet—

$$R = 1\cdot936\,(A\,0\cdot036 + 0\cdot084\,v^2)$$

Under the above circumstances, R the rate of falling is always inferior to the value of x given by the equation

$$10 = 1\cdot936\,(0\cdot036 + 0\cdot084\,x^2)$$

x being obviously enough the velocity for which R = to the weight pressing on the unit of surface. When the motion is such the velocity cannot be increased. If we make the calculation it is easy to see that the velocity is about 7 metres per second, almost = the fall from 3 metres to the ground. It is large, but not too large for a practised jumper, if he were clever enough to keep his balance, which is not very easy, it must be confessed.

Experiments on parachutes show that great oscillations always take place if the experimenters have not placed a small hole in the centre of their parachute, which increases stability at the expense of resistance. The motion of the wings, if they are working together, would very likely render the same service to the occupant of the machine, as they prevent the accumulation of the air. Unfortunately, to keep them working evenly is a difficult matter, requiring not only force of muscle but great presence and firmness of mind. The so-called *queue* or rudder was a useless encumbrance. A man working hard with his two hands, fighting for his life, cannot be expected to attend to direction with his legs attached to a rudder. The lifting power of the wings must have been very small indeed, although diminishing in some respects the rate of falling; but it is not easy to understand how a calculation may be made of the amount of mechanical power exerted in each stroke. The question must be left open for future examination.

W. DE FONVIELLE

NOTES

A CIRCULAR has been issued by the Hon. Local Secretaries of the Belfast meeting of the British Association, calling attention to the numerous objects of interest, natural and mechanical, with which the town and neighbourhood of Belfast, as well as the county of Antrim, abounds. The whole Province of Ulster is full of objects of the highest interest to the admirer of natural scenery, to the geologist, the naturalist, and the antiquarian; and many of its most interesting localities, such as the Antrim Coast, the Giant's Causeway, the Mourne Mountains, Lough Neagh, the Round Towers of Antrim and Drumbo, are within an easy distance of Belfast. The local secretaries state that a large number of the hotels will be open to members of the Association at the usual charges, and that a list of persons willing to let rooms has been prepared. We sincerely hope that this time there will be no complaint to make on the score of accommodation. Conveyance to Belfast can be obtained from any part of the country at very reasonable rates.

THE Right Hon. Lord O'Hagan will preside over the Section for Economic Science at the meeting of the British Association.

A MEETING of the General Council of the Yorkshire College of Science was held at Leeds on the 17th inst. The Council proceeded to the election of the Professor of Geology and Mining, and the Professor of Physics and Mathematics. The vote of the Council was unanimously given to Mr. A. H. Green, M.A., late Senior Fellow of Gonville and Caius College, Cambridge, as Professor of Geology; and Mr. A. W. Rücker, M.A., Fellow of Brasenose College, Oxford, as Professor of Physics and Mathematics. Prof. Green for the last five years has held the appointment of Lecturer on Geology at the School of Military Engineering at Chatham. Prof. Rücker in Oct. 1871 was appointed Demonstrator in the Physical Laboratory of Oxford University under Prof. Clifton. The appointment of the Professor of Chemistry will be made on Friday. The Council recorded a cordial vote of thanks to Sir A. Fairbairn for his liberal offer of 2,000*l.*, provided that the sum of 60,000*l.* was placed in the hands of the treasurer, and resolved to take the necessary steps for raising the required amount.

AT King's College, London, the Chair of Zoology and Comparative Anatomy, vacated by the resignation of Prof. T. Rymer Jones, F.R.S., has been filled by the election of Mr. A. H. Garrod, Fellow of St. John's College, Cambridge, and Prosector to the Zoological Society. The Chair of Materia Medica and Therapeutics, vacated by the resignation of Prof. A. B. Garrod, M.D., F.R.S., has been filled by the election of Dr. E. B. Baxter, Medical Tutor to the College.

THE prospectus has just been issued of a company to establish an aquarium for London, close to Westminster Abbey.

A BALLOON experiment to test a steering apparatus is soon to be made under the auspices of the authorities at Woolwich.

NORTHUMBERLAND, in Pennyslvania, on the Susquehannah, the place where Dr. Priestley was buried, has been selected by Americans as the spot at which all chemists are invited to gather on August 1 next, the hundredth anniversary of the discovery of oxygen by the illustrious philosopher. An address is to be delivered over his grave. This proposition of Dr. Bolton has met with a cordial response from a large number of chemists. Prof. Henry, of the Smithsonian Institution, proposes to be present with some of the original apparatus of Priestley from the Smithsonian collections. August 1 falling on Saturday, the meeting will be called for the day previous. A programme will be soon issued by the committee in charge.

THE Governing Body of Christ Church, Oxford, have voted the sum of 100*l.* per annum for five years in aid of the Biological Department of the Museum.

THE New Falcons' Aviary in the northern part of the Zoological Society's Gardens beyond the canal has just been completed, and is now tenanted by a fine series of the Diurnal Birds of Prey, principally exotic. Amongst them are examples of several rare species, such as the Red-backed Buzzard (*Buteo erythronotus*), the Laughing Eagle (*Herpctothires cachinnarus*), and the Malayan Crested Eagle (*Spizaëtus caligatus*). Amongst the less-known European species are a pair of Bonelli's Eagles, a pair of Red-footed Falcons, and an Eleonora Falcon.

M. Dourneau Dupré, a French explorer of the Sahara, has been killed by marauders on the way from Ghadames to Rhat. French colonists are making great progress in opening through the desert a road to Senegal by Timbuctoo and Niger; but Algerian refugees are their most determined opponents. The prospect of introducing water from the Mediterranean into the Chott has created a sensation in the colony and is very likely to lead to new efforts in desert exploration.

M. de Lesseps' scheme for making an inland sea in Algeria seems to have excited great alarm in some of the French journals. It is feared that the resulting evaporation will have a bad effect on the climate of France, one journal going so far as to suggest a return of the glacial epoch!

We have just received the first two parts of a new monograph on the *Trochilidæ* or Humming Birds, by M. E. Mulsant, the well-known coleopterist, and the late M. E. Verreaux.

The second series of the superb work "On the Butterflies of North America," by Mr. William H. Edwards, has just been commenced with the appearance of Part I. and with the promise of even greater beauty and excellence than the one recently closed. The illustrations, as in the preceding series, were drawn by Miss Mary Peart, who has made a specialty of this branch of art, and coloured at the establishment of Mrs. Bowen, of Philadelphia. The work bears the imprint of Hurd and Houghton, New York.

We understand that Lieut. Cameron's journal, giving an account of his journey from Unyanyembe to Ujiji, has arrived in this country. He passed over a new route, to the south of that traversed by Capt. Burton, and north of Stanley's; and has thrown much light on the geography of the southern half of the Malagarazi drainage area. He has obtained several latitudes, and took a series of hypsometrical observations; but his most important work has been the final settling of the questions respecting the height of lake Tanganyika above the sea; and the latitude and longitude of Ujiji. Lieut. Cameron has recovered, at Ujiji, a most important map drawn by Dr. Livingstone, of the unknown country between Mikindany and Lake Nyassa, without which the record of the great explorer's discoveries would be very incomplete. Lieut. Cameron found the country between Unyanyembe and Ujiji in a more dangerous and unsettled state than ever. Mirambo and an independent body of runaway slaves were in complete possession of the route; and, though they would not molest an English officer, no Arab caravan or body of negroes could have passed. The insurgents attack and drive back all such parties, and the people would destroy all their food rather than give it to them. Lieut. Cameron's labours, first in his gallant attempts to succour Livingstone, then in furnishing aid to the explorer's servants, who brought down his body and effects, and finally in pressing onwards, in the face of great dangers and privations, to recover the journal and map at Ujiji, are deserving of the admiration of his countrymen. He is now on the verge of new discoveries, and resolved to achieve them; and we trust there will be a liberal response to the appeal for funds. Subscriptions to the Cameron Expedition Fund are received by Messrs. Ransom and Co., 1, Pall Mall East.

In a paper in Petermann's *Mittheilungen* (Heft vii. 1874) by Dr. Joseph Chavanne, of Vienna, on "The Arctic Continent and Polar Sea," the author deduces the following conclusions from the data furnished by recent expeditions, and which he carefully discusses:—1. The long axis of the arctic land-mass (which probably consists of an island archipelago separated by narrow arms of the sea, perhaps only fjords) crosses the mathematical pole; it thus bends round Greenland, north of Shannon Island, not towards the north-west, but runs across to 82° or 83° N. lat. in a northerly direction, proceeding thence towards N.N.E. or N.E. 2. The coast of this arctic continent is consequently to be found between 25° and 170° E. long. in a mean N. lat. of 84° and 85°, the west coast between 90° and 170° W. long. in a latitude from 86° to 80°. 3. Robeson Channel, which widens suddenly north of 82° 16′ N. lat., still widening, bends sharply in 84° N. lat. to the west; Smith Sound, therefore, is freely and continuously connected with Behring Strait. Grinnell Land is an island which probably extends to 95° W. long., south of which the Parry Islands fill up the sea west of Jones's Sound. 4. The sea between the coast of the arctic polar land and the north coast of America is traversed by an arm of the warm drift-current of the Kuro Siwo, which pierces Behring Strait, and thus at certain times and in certain places is free of ice, allowing the warm current to reach Smith Sound. 5. The Gulf Stream gliding between Bear Island and Novaya Zemlya to the north-east washes the north coast of the Asiatic continent, and is united east of the New Siberia Islands with the west arm of the drift current of the Kuro Siwo. On the other hand, the arm of the Gulf Stream, which proceeds from the west coast of Spitzbergen to the North, dips, north of the Seven Islands, under the polar current, comes again to the surface in a higher latitude, and washes the coast of the arctic polar land, the climate of which, therefore, is under the influence of a temporarily open polar sea; hence both the formation of perpetual ice, as well as excessive extreme of cold, is manifestly impossible. 6. The mean elevation of the polar land above the sea diminishes towards the pole. 7. The sea between Spitzbergen and Novaya Zemlya to Behring Strait is even in winter sometimes free of ice, and may be navigated in summer and autumn. 8. The most likely routes to the pole are:—first, the sea between Spitzbergen and Novaya Zemlya; and second, the sea north of Behring Strait along the coast of the unknown polar land.

A new geological survey of the State of Pennsylvania has been ordered, and the bill providing for it has passed the Legislature and has received the signature of the Governor. Money for three years has been voted. Prof. J. P. Lesley, of the University of Pennsylvania, has been appointed Geologist-in-Chief.

The programme of arrangements for the thirty-first annual meeting of the British Archæological Association is just out. The meeting will be held at Bristol in the week between Aug. 4 and 11, under the presidency of Mr. K. D. Hodgson, M.P. Excursions will be made to various places of interest in the surrounding district. Among the papers to be read at the evening meetings are the following:—On unpublished historical documents at Bristol, by W. de Gray Birch, Hon. Palæographer; and On the records of Merchant Adventurers, by Mr. J. de Haviland.

We learn from the Report of the Radcliffe Observer that the number of transits observed from July 1, 1873, to July 1, 1874, is 3,093; and the number of zenith-distances, 4,101. The number of stars observed in the same interval is 1,585. Coggia's comet has been observed four times on the meridian and four times with the heliometer. With the heliometer, in addition to a small selected list of double stars which have been observed as usual, a series of ten measures of the equatorial and polar diameters of Jupiter has been made, and the diameter of Uranus has been measured several times. These observations have been made chiefly by Mr. Bellamy. The volume containing the results of observations for 1871 is complete and ready for distribution. This volume contains a catalogue of 1,331 stars:—97 observations of the sun, 51 observations of the moon, 25 of Mercury, 18 of Venus, and 14 of Mars; a catalogue of 21 double stars, of which several have been observed repeatedly; 11 measures of the equatorial and polar diameters of Mars, with the deduced apparent ellipticity, and diameter at mean distance; 8 occultations of stars by the moon, with the equations deduced from the occultations; and, finally, a considerable list of shooting-stars observed chiefly by Mr. Lucas. Considerable advance has also been made in the reductions for 1872-73.

WE would draw special attention to the Catalogue of the Anthropological Collection lent by Col. Lane Fox for exhibition in the Bethnal Green Museum. Only Parts I. and II. have been yet published, and these are almost entirely occupied with Weapons, which are divided into various classes, the lists under the various classes, or rather the contents of the various screens on which the specimens are arranged in the museum, forming the subjects of dissertations by Col. Lane Fox, who endeavours to trace out the probable origin and development of the various kinds of weapons. The principles which have guided Col. Lane Fox in making and arranging his valuable collection, he pointed out in his paper read at Bethnal Green on July 1, an abstract of which will be found in our last number, p. 217. He has abandoned the mere geographical arrangement, and adopted a principle as scientific, and we hope as productive, as that which obtains in natural history. A student of anthropology going carefully over Col. Lane Fox's collection at Bethnal Green, with this catalogue in his hands, would find himself both interested and instructed to a degree that it would be difficult to attain anywhere else.

WE rejoice to see from the tone of the replies to questions in the House of Commons on Monday by Mr. Disraeli and Lord Henry Lennox, that Government is conscious of how poorly housed some of our scientific collections are, and seems really disposed to take steps to remedy the evil. Mr. Disraeli said, in reply to a question concerning the Patent Museum, that it is not the only public institution which is suffering from want of space and of suitable accommodation. "That is now a crying grievance with respect to all our public buildings, collections, and offices. In regard to the Patent Museum, however, I am aware from a communication which I have received from my noble friend the First Commissioner of Works, that the matter is at present engaging attention." Lord Henry Lennox confirmed this by subsequently stating that he intended to propose to Her Majesty's Government a scheme which, if it were agreed to, would enable him to offer the Patent Museum suitable accommodation in the southern block of the International Exhibition buildings.

MR. JOHN MURRAY has in the press a memoir of Sir Roderick I. Murchison, based upon his journals and letters, with notices of his scientific contemporaries, and a sketch of the rise and progress, for half a century, of Palæozoic geology in Britain, by Prof. Archibald Geikie, LL.D., F.R.S., &c. It will be illustrated with portraits, and will be published in two octavo volumes.

MR. KARL TRÜBNER, of Strasburg, has recently published one part of a geological map of the neighbourhood of Heidelberg, the work of Drs. Benecke and Cohen. We especially draw attention to the fact that contour lines are given faintly marked in red. The other part, and the letter-press description, will not be ready till next year.

M. CAILLETET, in studying the compressibility of gases, has been led to investigate the resistance which glass tubes oppose to pressure. In one experiment a tube 21·7 in. long, and 0·7 in. diam., was crushed by an outside pressure of 77 atmospheres, while half that pressure sufficed to break it when exerted on the interior.

THE Geologists' Association has organised a lengthened excursion to the Cotteswold Hills, May Hill, and the Severn Valley, extending from Monday last, July 20, to Saturday, July 25. The head-quarters is at Cheltenham. Judging from the programme this excursion promises to be one of great interest; the directors are Dr. Thomas Wright, F.G.S., Mr. J. Logan Lobley, F.G.S., Mr. W. C. Lacy, F.G.S., and the Rev. W. S. Symonds, F.G.S.

THE first volume of the United States Commission of Fish (8vo, 899 pp., 38 plates and 3 maps) has been recently issued from Washington. In addition to reports of proceedings there are given arguments for and against protective laws, the natural history of some of the most important food-fishes; catalogue of marine algæ of southern New England; and papers on physical characters, invertebrate animals, &c., of different districts.

FOLLOWING the report of the Inspectors of Salmon Fisheries in England and Wales, that from the Inspectors in Ireland has just been issued, containing statistics concerning not only the salmon fisheries, but the deep-sea and coast fisheries as well. It is difficult, from the form of the report, to give any general idea of the condition of the salmon fisheries, but they appear to be slightly increasing in productiveness. The same complaints are made in Ireland as in England of the dangers from pollutions, and from the want of passes over the weirs. But the inspectors do not appear to have done anything to remedy either of these evils. The oyster fisheries are in a decaying state, and the beds licensed to private persons are almost unproductive; naturally better situated than England for the production of oysters, it seems a great pity that Ireland should not yield a large number of these molluscs, if proper care were only taken, and a little energy and capital expended in improving the beds. The herring fishery for the year was less than in 1872, while the mackerel fishery was nearly double; pilchards, however, are almost unutilised, though the mass of wealth in the waters is sufficient to make an industry that would rival that of the Cornish fisheries. If the inspectors could put a little energy into the matter and the people be made to see their opportunities, the fisheries of Ireland might be the richest in the world.

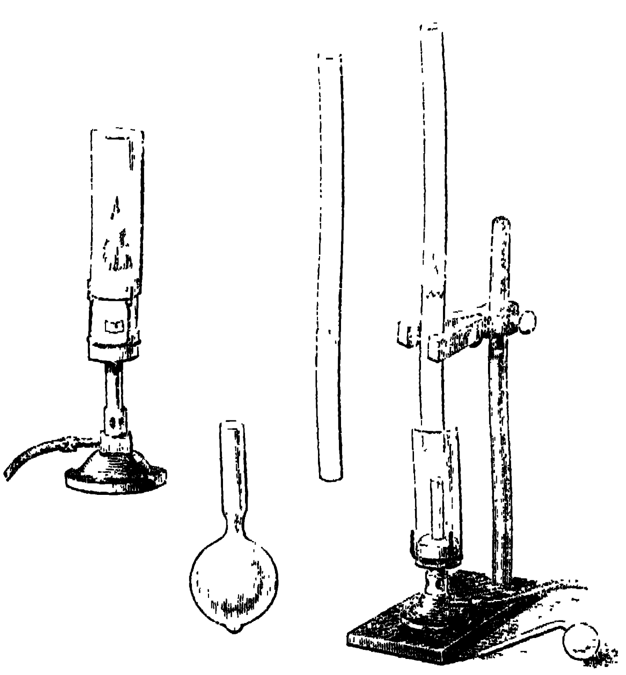
THERE appears a prospect of good coal being shortly made available for consumption in Japan. The largest of the coal-fields of Japan, that of Takosima, has come into possession of the Japanese Government, and it is hoped that an increased outlay of capital will produce satisfactory results.

THE *New Quarterly Magazine* for July contains, among other articles, an essay On birds and beasts in captivity, by Archibald Forbes, and an interesting paper by Mr. Evershed, On habit in plants and power of acclimatisation, in which, *àpropos* of the present state of the question of sewage farming, he remarks:—"It is a serious drawback to the profits of sewage cultivation that only certain plants are disposed to consume so much liquid as is offered to them under that system of management. Cereals are not drinkers to any large extent, and will not suddenly change their habits. They have enough to do to swallow the ordinary amount of wet which prevails in our climate, being naturally partial to rather drier countries like South Russia, Poland, and Spain."

THE additions to the Zoological Society's Gardens during the past week include three Giraffes (*Camelopardalis giraffa*) from Upper Nubia, purchased; two Passerine Owls (*Glaucidium passerinum*), European, presented by Mr. C. W. Tait; a Reeves' Muntjac (*Cervulus reevesi*), born in the Gardens; a Slow Loris (*Nycticebus tardigradus*), from the Malay region, deposited; a Coati (*Nasua nasica*), brown variety, and a Spotted Cavy (*Coelogenys paça*) from South America, purchased; two Bronze-winged Pigeons (*Phaps chalcoptera*) and an Olive Weaver Bird (*Hyphantornis capensis*), hatched in the Gardens.

VIBRATIONS OF AIR PRODUCED BY HEAT

DURING the past session an interesting experiment was made by some students of the College of Physical Science, Newcastle-on-Tyne, engaged in their practical course of chemistry in the laboratory, sufficiently striking and remarkable to secure it, I have little doubt, a short notice among the records of a scientific journal. While testing the inflammable properties of the explosive mixture of air and coal-gas proceeding from the mouth of an unlighted Bunsen-burner, and observing its flame kindle and flashing back along a glass tube, it occurred to one of the students and to the chemical demonstrator, Mr. Haigh, to check the flame in its descent by inserting a piece of wire-gauze in the tube. On reaching the wire-gauze the flame rested there, as they expected; not silently, however, but bursting to their surprise with remarkable clearness and loudness into the peculiar singing strain of the chemical harmonicon. Mr. Haigh made several experiments on the flame with tubes of different sizes, which, if more immediate engagements had not prevented me from pursuing them, it had been my intention to have varied, and to have examined them more completely. In the form in which it first presented itself, a convenient and easily intelligible arrangement of which is here sketched, it appears, however, to offer all the attractions and the remarkable strength and variety of singing properties with which it seems to be abundantly endowed. A cylindrical lamp-glass mounted with a cork and wire-triangle on a Bunsen-burner serves to shield the mouth of the tube from draughts of air, and to preserve a steady flow of the entering gas. The tube is first lowered over this and lighted at the top; by raising it gradually sufficient air soon enters with the gas below to make the flame waver on the top of the tube, and finally descend to the wire-gauze, where it then burns most vociferously, especially if the wire-gauze is placed at the best position in the tube to produce some of its harmonic notes. The highest notes are sounded when it is above the middle, or even near the top of the tube, and the lowest when it is not far from the bottom of the tube; the stronger draught arising from the long column of heated air, which soon greatly assists the sound, appearing in the latter case to favour the production of notes of the deeper pitch. A glass tube about 2 ft. long and nearly 1 in. in diameter inside furnished a very powerful note, the wire-gauze being placed a short distance below the middle of the tube. By bending down the edges of a square or circular piece of wire-gauze over the flat end of a round ruler so as to fit the tube correctly, all passage of the flame between it and the tube is prevented, but when, as quickly happens with the increasing heat and updraught of the tube, the agitation of the flame grows more and more intense, it at length red-heats the wire-gauze, and passing through it lights the Bunsen-lamp below. A very instructive illustration is thus afforded of certain conditions in which the security of Davy-lamps in a fiery atmosphere can no longer be assured, where a sufficiently quick draught, or in this case the pressure of continued vibrations, carries the flame against the meshes of the wire-gauze until they are ignited. In one case danger arises of the wind carrying the flame of one side of the interior of the lamp over to the other side, which it red-heats; in the present case the vibrations carry the flame back upon itself. If in the former case a red-heated Davy-lamp is not turned round quickly to face the draught, explosion does not always follow; but in this case the current of explosive gas is immediately presented to the heated gauze, and not having undergone any previous combustion it is of course quickly kindled. On the other hand, another source of insecurity of safety lamps when exposed to sudden vibrations, or to the shock produced by a fall, is well shown, when it sometimes appears to happen, if the flame flutters very strongly, that it strikes through the wire-gauze without red-heating it, and lights the lamp below. This may, however, have occurred from imperfect fitting of the wire-gauze to the sides of the tube, and it would be interesting to repeat it if possible with precautions for making the surrounding junction quite secure. A lighted Davy-lamp suspended by a wire in a tin tube 3 ft. or 4 ft. long and wide enough to admit it easily, through which a stream of coal-gas mixed with air was passing made the tube hum very loudly, but no explosion followed, perhaps because it was not found possible to produce in the lamp a sufficiently violent agitation of the flame. A remarkable example of the ease with which the wire-gauze flame excites the notes of even very short, wide-mouthed tubes can easily be shown by inserting a well-fitting piece of wire-gauze 1 or 2 in. from the lower end of a straight lamp-glass, as shown in the sketch, and supporting this a few inches above an unlighted Bunsen jet. When the gas is lighted on the top of the wire-gauze and the heat of the glass chimney becomes sufficient to increase the draught, which may also be adjusted by varying the gas supply to the glass, its shrill treble note is sounded at once with overpowering loudness. The sensitiveness of the wire-gauze flame to acoustical impressions was, I believe, demonstrated very recently by Prof. Barrett, by many new and striking experiments on the depression of its luminous cap or top in obedience to the voice and to other sounds; and I have been assured both by Prof. Tait and by Prof. Marreco that the use of the smokeless wire-gauze burners, common in laboratories before the introduction of Bunsen's lamps, for exciting the hoarse music of singing flames in tubes of large calibre has long been familiar to them as a thoroughly effective means of reproducing the chemical harmonicon with common coal-gas. The easily inflammable nature of well aërated coal-gas combined with the conducting and quenching power of wire-gauze on flames which it supports, supplies an obvious explanation of the responsive vibrations of the flame to any description of rhythmical surrounding agitations and impulses. I was not, however, prepared for an equally remarkable and peculiar property of heated wire-gauze to the above, which, like the last experiment, was also shown to me by Mr. Haigh in some of his trials of the sounding tubes. When the flame had been sounding strongly and the gas was turned off to extinguish it, instead of ceasing immediately the musical note continued for a considerable time, sometimes even gaining a little in strength before it died away, the tube then appearing to have the power of intoning spontaneously without the presence of any visible exciting cause. That the source of these prolonged vibrations is the heat communicated to the wire-gauze, which enables it to expand the air by impulses in the tube as the ascending current gradually passes through its meshes was confirmed by a variety of experiments, all pointing to this origin of the sound as its real explanation. It happened on one occasion, when the flame passed through the gauze, lighting the Bunsen-lamp below, and leaving the gauze red-hot, that on putting out the lamp the after-note sounded so long and loudly as quite to equal, if it did not even surpass what had just been emitted by the flame. To reproduce the same note it is in fact only necessary to red-heat a wire-gauze diaphragm inserted a few inches above the lower end of a pretty wide glass tube over a Bunsen-flame, and to remove it from the lamp, when the gravest note of the tube will immediately be sounded with all the strength and purity that can be desired. Somewhat coarser wire gauze than that used for the singing-flame succeeds the best, as, besides being more easily red-heated by the Bunsen-flame, it furnishes a larger store of heat to the ascending air-current, which, in passing through its meshes, produces the singing sound. If the tube is raised quickly, the draught through it being thus checked it stops, and as soon as it is brought to rest



it begins to sing again; by lowering it quickly the note is much strengthened, as it is also by turning on an unlit gas-jet under it, and especially by swinging the tube round horizontally, the lower end foremost through the air, which increases the draught and the strength of the note most considerably. The note is silenced when the tube is held at rest inverted, or horizontally, but it begins again as soon as the tube is restored to its erect position. A closely twisted coil of thin platinum wire was compressed in the tube in the place of the wire-gauze, and was made red-hot over the Bunsen-flame, which was then extinguished, and the gas again turned on immediately, causing the platinum wire to continue to glow by catalytic action. As long as its red-heat continued, the musical sound of the tube also continued to be produced. A glass tube 2 ft. long by 1¼ in. in diameter, stopped near one end with platinum wire-gauze, to the centre of which a small piece of spongy platinum is fastened, performs in this way over an unlighted gas-jet, when started by preparatorily heating the platinum gauze, for any length of time. Although unable to do so over ordinary coal-gas, yet it is very probable that over hydrogen (as a heat below redness is sufficient to maintain the sound) a tube thus fitted with pieces of platinum sponge laid upon wire-gauze would start and continue to sound by itself.

When a glass bulb is blown at the end of a glass tube it frequently happens that in cooling it emits a very clear and distinct humming sound. The note has appeared to me considerably graver than what would be expected from air vibrations in the small bulbs in which it occasionally occurs; thus in blowing the small candle-bomb, shown of its proper size on the left hand in the figure, a very loud note, of apparently about middle C pitch, or even lower, accompanied its cooling. In drying the glass bulb of a broken Wollaston's cryophorus, shown with its bent tube on the right in the sketch, by warming it very gently over a gas-flame to expel some adhering moisture, I was startled on removing it from the flame to hear the same humming note, although the bulb was scarcely hotter than could be touched with the hand, resembling in pitch (although its softness may have had a misleading effect upon the estimate) one of the lowest bass notes of an organ. Being familiar with the depth of tone obtainable with Helmholtz's spherical resonators, I am led to suppose that the combination of a bulb with a tube may have a much lower fundamental note than either of those cavities would have alone. But the acting source of the note requires also to be considered, and if, as appears evident, low beats and resultant tones cannot be reinforced without strengthening their primaries, the deep pitch of bulb-emitted notes may possibly arise from the nature of the air impulses by which they are produced. These appear to be of the same kind as the air-oscillations in the hot-gauze harmonicon. As the energy of the sound-waves cannot be produced without a corresponding motive cause, in the latter it is the ascending current of the rarefied, and in the former the in-draught of the contracting air, both produced by the dissipation or appropriation of a certain store of heat. The cold air entering the hot bulb or ascending through the heated wire meshes, expands in doing so, recoils upon itself, and throws the air column of which it forms a part into vibrations, which continue as long as the flow of air and heat together continue to support the motion. The rapid succession of explosions of the gas-flame harmonicon are, in fact, reproduced; the expansive force of the small puffs or explosions that produce the sound being merely derived from a limited stock of sensible heat, instead of from a constant supply of heat of combustion. Considering the volume and duration of the sound long after the wire-gauze has ceased to be visibly red-hot, the energy of the effect produced by the heated gauze seems to be out of all proportion to its magnitude; but the effects of the mechanical transformation of heat are, as is well known, always sufficiently startling, and sometimes even prodigious when the conditions under which it takes place are at all favourable to the process of the transformation.

I was not aware, when writing this description, that musical sounds produced by heating glass bulbs had been examined so long ago as the beginning of this century, as described in Prof. Tyndall's work on Sound, by the late G. De la Rive, who obtained them by boiling water in thermometer bulbs. The vapour in its passage along the tube is condensed, and by the collapse that accompanies its contraction throws the air column in the tube into vibration; this action is thus exactly the opposite of what occurs when fresh-blown strongly heated glass bulbs are allowed to cool, the expansion, instead of the contraction, then giving the necessary impulse. I am also disposed, since reading Prof. Tyndall's description and explanation, to ascribe the low note of the warmed cryophorous bulbs to the escape of aqueous vapour from it in the manner of De la Rive's experiment, rather than to the influx of cold air into the bulb to which I attributed it at first.

It is well known that at a nodal point of a vibrating air-column there is no oscillation, but alternate expansion and contraction of the air, while in the middle point of a vibrating segment the opposite is the case. Neither of these places is accordingly a suitable one for the combined air-pressures and oscillations to take place, which in a sounding flame or at a heated diaphragm can never occur separately or independently of each other, the strength of each little puff or explosion depending at once upon the direction and amount of the contributing oscillation; the position of the heating cause must accordingly be between the ventral and the nodal points. It is the same with the air-currents that excite the vibrations of a flute, railway whistle, common bird-call, or organ-pipe; the oscillations and throws of pressure of the air at the embouchures are not only simultaneous, but they must also be so related to each other that an inward oscillation accompanies increase of pressure, since a part of the blast is then thrown into the air-column and compresses it. From an easy law connecting together the changes of pressure with the motion of the air at any point of a stationary air-wave, it appears that in these instruments, exactly as in the hot-bulb, or in the hot-gauze and gas-flame harmonicon, the ventral point (as far as a true one exists) is not at the embouchures of the wind-instruments, nor at the heating and cooling points of the several kinds of heat-sirens or harmonicons, but outside of them in such a position as to place the exciting air-puffs between the nodal and the ventral point. Prof. Tyndall has truly pointed out in his sound lectures that whenever stationary undulations are kept up against friction, as when a stretched string is kept in uniform vibration by the hand, the nodal points are not absolutely stationary points, but present a little oscillation. It is equally true that the string does not remain accurately parallel to itself where it ought to show true ventral points, and accordingly resists a hand applied there to keep up its oscillations with a certain force; but this resistance is weak, and it acts through a wide excursion, while near the nodal points the necessary efforts of the hand are greater and exerted through very small displacements. In intermediate positions the nearer the string is held to a nodal point, and the smaller its excursions, the stronger must be the jerks given to it by the hand to keep up its oscillations. In air-instruments (including the harmonicon and flute) the jerks of the hand correspond to the explosive force of the small admitted puffs of air, depending in heat-harmonicons on the intensity of the heat or combustion, and also on the quantity of the matter burned or heated in the successive puffs; and in wind-instruments no doubt principally on the pressure and perhaps to some extent also on the quantity of the admitted blasts. According to the position of the embouchure (including a flame-jet or a heated gauze under the expression) in the vibrating segment of a wave of resonance, its beneficial action in maintaining the air-wave will be evoked or suspended in obedience to the particular conditions that exist in the air-wave at that point; the only absolute requirement for its activity being that entanglement of a fresh supply of blast must coincide with a moment of rising pressure at that point of the air-wave. This is easily accomplished in wind-instruments, the large excursions of the air at the embouchures ensuring a plentiful introduction of the entering wind-puffs at the proper time; the action in this case is quite free from complication, as without considering the small gains of pressure periodically given by the blast as it flows inwards, and a small suction that it exercises (to which I believe that Mr. Hermann Smith is the first to draw attention in his excellent communication on this subject in NATURE, vol. x. p. 161), as it retreats, nothing prevents the to-and-fro displacements at the mouth of an organ-pipe from so deflecting the current of the air-blast inwards and outwards as constantly to apply its useful energy to the best effect. Inward motion of air towards a node is accompanied by rising and outward motion by falling pressure, and as the losses of both of these kinds of energy are properly renewed by the blast in entering or retreating, the resonance of the wind-instrument is kept up. The friction and loss of energy in high harmonics is probably much greater than in graver notes, and, the air-excursions being also smaller, it is perhaps on this account that a stronger blast or a nicer direction of it by the mouth-piece is found necessary to produce and to maintain them. In heat-harmonicons the action is less simple, the alternations of pressure as well as the oscillations of the air determining the admission of the entering puffs. To judge from the position in which a singing-flame sounds best in a chemical harmonicon, a certain "lead" like that used in admitting steam to the cylinder of a steam-engine is necessary for the flames to exert their expansive force, the gas perhaps not instantly igniting on its emergence from the jet; and this "lead" the mere oscillations of the surrounding air are unable to supply; but in the position which the jet occupies in the tube, the air-pressures, which return at periods answering to a half stroke of the flame before the oscillations, precipitate its development and enable it to exert its pressures at the proper times. The proportion of lead given to the flame increases as it approaches the middle of the tube, where only the variations of pressure act upon it, while at the lower end of the tube it is commanded entirely, like the air-blast of an organ-pipe, by the oscillations of the air. It is perhaps thus that a wire-gauze flame burning at the foot of a lamp-glass sounds so vociferously, because stationary alternations of pressure in the lower part of the tube cannot affect the transmission of gas through the gauze, while the extensive oscillations there produced have perfectly free action in extinguishing and replenishing the flame. By using a piece of thin glass connecting-tube about 4 ft. long, held vertically over an unlighted Bunsen jet, on lighting the gas escaping at the top, and carefully raising the tube so as to allow the flame to descend very slowly, it may be made to pause in its descent at the successive ventral points corresponding to the harmonic divisions of the tube, sounding the note of the section of the tube above it as it comes to each point of rest. On lowering the tube it ascends, stopping and singing at some higher point of rest, depending apparently upon the less instantaneous inflammability of the gas. With some difficulty, and by shielding the lower end of the tube as much as possible from draughts, the flame was sometimes made to drop quickly within a few inches of the bottom of the tube, stopping always at the same place and sounding there for a moment the lowest note of the tube, when by the strength of its vibrations it was either rapidly extinguished, or else lighted the Bunsen lamp below. The notes sounded by these means were, however, not nearly so loud and effective as those obtained when the gas-flame was held at its stationary points by making it come to rest upon wire-gauze.

I am indebted for almost all of the foregoing experiments to Mr. Haigh, who was very skilful in suggesting and devising modifications of them, leading to the immediate conclusions regarding the mode of their production to which they appear most distinctly to conduct. Other occupations have hitherto prevented me from attempting to extend and to examine them as thoroughly as they seem to deserve; but the field of research presented by the study of harmonic flames does not yet appear to be nearly exhausted, and the repetition of the above experiments by others will perhaps throw more light upon the doubtful questions with which they are still to some extent surrounded, enabling, it may be, the many significant and easily-recognised features of singing flames to be produced with even more than their present ease and certainty. A. S. HERSCHEL

SCIENTIFIC SERIALS

THE *Geological Magazine*, July.—In this number Mr. J. Croll commences an article On the physical cause of the submergence and emergence of land during the glacial epoch, which is to be continued. As far as it goes it is concerned with the conceptions we have of the thickness of continental ice. An attempt is made to estimate the thickness of the great antarctic ice-cap, about which "observation and experience to a great extent may be said to be a perfect blank." The condition of the interior of the antarctic continent is inferred from the little that we know of Greenland. The diameter of the ice-cap being taken at 2,800, the thickness at the centre is given at the lowest at 6 miles, reckoning a quarter of a degree only as the slope of the upper surface. Mr. Hopkins has recorded that he found one degree the least slope on which ice will move. An ice-cap of only 6 miles in thickness is to many an unfamiliar idea, and "few things," Mr. Croll writes, "have tended more to mislead geologists in the interpretation of glacial phenomena than inadequate conceptions regarding the magnitude of continental ice."—The other original articles are On the dawn and development of life on the earth, by H. Woodward, F.R.S.—Notes on carboniferous monomyaria, by R. Etheridge, jun.—The geology of the Nottingham district, by Rev. A. Irving.—There are two letters on the glaciation of the south-west of England, by Dr. Mackintosh and H. B. Woodward.—Mr. Mallet writes that he does not see how he can be charged with "misapprehending" Mr. Scrope in the discussion on the nature of volcanic heat, and asks that as he has reduced his own views to clear definition (Phil. Trans., vol. i. 1873) Mr. Scrope will do the same.

Bulletin de l'Académie Royale des Sciences, &c., de Belgique, No. 5.—M. Van Beneden contributes the first part (65 pp. in length) of a paper entitled "On the original distinction between the testicle and the ovary; the sexual character of the two primorial layers of the embryo; the morphological hermaphroditism of an entire 'individual'; an essay on the theory of fecundation." The "essay" opens with an introduction in which reference is made to Huxley's first pointing out that the organism of Zoophytes, Medusidæ, Polyps, Siphonophora and Hydroideæ consists essentially of two layers, endoderm and ectoderm, and also to other writers who have studied the relationships of endoderm and ectoderm in various aspects. The second part contains the history and bibliography of the subject, and the third (50 pp. long) describes the author's researches on *Hydractinia echinata*, made during a lengthened visit to Ostend. He first describes the characters which the male and female reproductive zooids have in common, and carefully details his methods of preparation. The microscopic description of the female and then of the male zooids or gonosomes is given in much detail, illustrated by plates. He arrives at the following conclusions:—The ovaries are developed entirely from the epithelial layer of the endoderm. Up to the time of maturity they remain entirely surrounded by the elements of the endoderm. The testicle and spermatozoa are developed from the ectoderm. The female sporosacs contain rudimentary testicular organs, and male sporosacs a rudimentary ovary. From a sexual point of view the ectoderm and endoderm have an opposite signification. If it is true that special organs have resulted from specialisation of function following division of labour, then we must believe that originally the whole ectoderm performed the male sexual function and the endoderm the female. The ectoderm is the animal and male layer, the endoderm the vegetation and female. Fecundation consists in the union of an egg, the product of the endoderm, with the product of the ectoderm, which brings chemical compounds of "opposite polarity" into union. The new individual is formed at the instant the elements of "opposite polarity" unite just as a molecule of water is formed by the union of atoms of hydrogen and an atom of oxygen.—M. Henry contributes papers on chloral and chlor-ethylic ethers, &c.—M. F. Plateau has sent in a communication on the digestion of insects, which is to be published in the memoirs.

Bulletin de la Société d'Anthropologie de Paris, t. vii.—In the seventh volume of this journal M. Hamy gives us the results of his examination of M. Janneau's officially conducted investigations into the anthropology of Cambodia. He begins by endeavouring to define the meaning attached to the three words, "Moi," "Kha," and "Penang," which have hitherto been used in Annamite, Laolian, and Kmer almost indiscriminately to indicate the wild tribes of the hills. By the first of these we must understand the negro tribes occupying the oriental chain of the Cambodian range; in the second a people not unlike the yellow races of Laos; and in the third the tribes in whom the flat-faced non-Caucasian type is strongly marked. The Cambodians themselves distinguish between races, known as Kuôi, who, they say, are the primitive people of the land but not savages, and the Rodê, the former being employed in the extraction of the ores of Kompong Svai, and the latter in the breeding and care of horses, while both are exempt from the yoke of slavery which presses heavily upon nearly all the other tribes. In the Cambodian language M. Janneau thinks he can trace evidence of identity with many of the primitive forms of the roots of the mother-tongue of the Indo-European languages. The Aryan name "Rama" appears among the ancient regal titles of Cambodia, and while the Sanscrit "Ramayana" includes the Cambodians amongst the offspring of the immaculate cow, Cabala, the people themselves have from the most remote antiquity made the cow the object of special adoration.—The question of the depopulation of certain districts, more especially in the Polynesian and other Australasian insular groups, has lately attracted especial attention among the members of the Anthropological Society of Paris. The Gambier Islands, which in

1838 had 2,000 inhabitants, had in 1872 only 650. M. Leborgne shows, however, that although alcoholism does not exist in these islands, where fevers and smallpox are unknown, rheumatic, neuralgic and nephritic affections are not uncommon, whilst phthisis and scrofulous degeneration are attended by a frightful mortality, which seems to point to the injurious results of consanguineous unions. M. Broca is disposed to attribute the gradual diminution of the Polynesian and other analogous peoples to the moral action of certain depressing influences to which savages are exposed when they find themselves brought suddenly in contact with civilised men. The very contact of civilisation seems to exert in and for itself a destructive action on their physical nature. M. de Quatrefages considers, in a separate paper, the same question in reference to the general diffusion amongst the Polynesian races of tuberculosis, which was not observed by the early discoverers, but has now attained such dimensions that its presence could scarcely escape the notice of the least observant travellers. In the universality of its destructive action on all the Australasian islands, M. de Quatrefages sees another and most incontrovertible evidence of the unity of the entire race.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, June 15.—In this number is commenced a review by Herr Fritsch of M. Poëy's "New Classification of Clouds," published in the *Annales Hydrographiques*. After insisting on the importance to sailors, farmers, gardeners, and others, of a knowledge of clouds with a view to prediction, M. Poëy has remarked how few observers have recorded the kind of cloud, the shape, rate of movement, course, and change of direction or shift, which differs with the height at which it floats. The ideas of men who have busied themselves with clouds, from Aristotle to Maury, are commented upon and criticised. Lamarck was the first to divide clouds into classes, and Howard's system, which followed independently a year later, differed but slightly in the main from that of the French naturalist. The stratus of Howard he regards as nothing but a fog, and the cumulo-stratus as a cumulus. His own fracto-cumulus resembles Lamarck's "attroupés," and his pallio-cirrus and pallio-cumulus, determined by observation in the Antilles, replace the nimbus of Howard. The sub-divisions of Admiral Fitzroy, based merely upon quantity, lead to error. As to the stratus, the first mistake arose from its being described as a mist by Howard himself, and the next from his followers raising the thin streak of fog to the dignity of a cloud. For Kamtz says of the cirro-stratus, that when seen at the zenith it appears to be made up of a number of cloudlets, but near the horizon like a long and very narrow streak. This cloud might therefore be confused with the stratus as represented, especially as both are common at sunrise and sunset. This error, namely, making the stratus anything but a fog, has been followed in all publications since 1815, including one of Kämtz in 1840, and the plates of Schübler, of the Smithsonian Institution, of Maury, and of the French Ministry of Marine (see NATURE, vol. ix. p. 163).

Reale Istituto Lombardo. Rendiconti: t. vii. fasc. vi., March.—The following papers are contained in this number:—In hydraulics there is a paper by M.E. Lombardini, On floods and on the inundation of the Po in 1872.—In experimental physics, Prof. Rinaldo Ferrin contributes a paper On the reversal of the current in Holtz's electric machine.—Prof. Alfonso Corradi contributes a paper to the history of medicine on certain unpublished writings of Morgagni.—Tome vii. fasc. vi., April, contains the following papers:—In the section of mathematical and natural science there is an anthropological paper by Prof. Cesare Lombroso, On tattooing amongst criminals in Italy.—In chemistry there is a note by Prof. Egidio Pollacci, On the action of sulphur on earthy carbonates, particularly on calcium carbonate as relating to geology and agriculture.—In mechanics, Prof. Giuseppe Bardelli contributes a mathematical note entitled "Researches on the moment of inertia."

Fünfzigste Jahresbericht der Schlesischen Gesellschaft für Vaterländische Cultur (1872).—This Society has its head-quarters at Breslau, and, according to the present report, numbers 443 acting, 32 honorary, and 198 corresponding members. It is at present under the presidency of Dr. Göppert. The account of proceedings, now before us, attests considerable vigour and industry during the year. In the department of natural science, perhaps the most important paper is that of Prof. Cohn, giving the results of his observations on Bacteria, and their relation to putrefaction and contagion.—Dr. Roemer reports on some bone-remains of rhinoceros found in the Trachenberg; and Dr. Göppert traces the history of the elk in Silesia.—The family of the Cirratulides is described by Prof. Grube; and we also find accounts of a collection of Javan birds, and Transcaucasian insects in the Society's museum, and of plant-eating Cetacea.—Dr. Poleck discusses the experimental bases of the so-called modern chemistry.—Prof. Cohn's report in the botanical section is of considerable length. We may note in it Dr. Stenzel's paper, On the Riesengebirge as a limit of vegetation. He finds that about thirteen species of phanerogam and cryptogam vascular plants belong only to the Silesian side, and about as many only to the Bohemian side of the range. The entire number of plant species in that highland region is estimated at about 200, so that about an eighth finds its limit at the watershed of the range.—There is also an instructive paper by Prof. Göppert, On the relation of the plant-world to weather.—Dr. Schröter communicates a list of the fungi he has met with at Rastatt during a four years' residence; and Dr. Göppert reports on the fungus collection in the museum of the Botanical Garden in Breslau.—Descriptions of flora of the Grünberg and other localities in Silesia are furnished by various observers.—The Society has a section specially devoted to horticulture, and the report on this, presented by M. Müller, contains a good deal that will be found of value by the practical gardener.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, June 24.—John Evans, F.R.S., president, in the chair.—The following communications were read:—New Carboniferous Polyzoa, by Prof. John Young, and Mr. John Young, Hunterian Museum, Glasgow University (see NATURE, vol. ix., p. 456).—On *Palæocoryne* and other polyzoal appendages, by Prof. John Young and Mr. John Young, Hunterian Museum, Glasgow University.—The steppes of Siberia, by Thomas Belt. The author described the portion of the Siberian steppes traversed by him as consisting of sand and loam. The best section seen by him was at Pavlodar, where he found 1 ft. of surface-soil, 20 ft. of stratified reddish-brown sand, with lines of small gravel, 8 ft. of light-coloured sandy silt, 15 ft. of coarse sand, with lines of small pebbles and one line of large ones, and 6 ft. of clayey unlaminated silt, with fragments of the bed-rock in its lower half, the bed-rock being magnesian limestone much crushed at the top. The generally accepted marine origin of the great plain was said to be negatived by the absence of sea shells in its deposits, whilst *Cyrena fluminalis* occurs in them. The author regards them as deposits from a great expanse of fresh water kept back by a barrier of polar ice descending far towards the south. In its greatest extension this ice-barrier would produce the crushing of the bed-rock; and as it retreated, the water coming down from the higher ground in the south would cover a continually increasing surface.—On the microscopic structure and composition of British Carboniferous dolerites, by S. Allport.—Additional remarks on boulders, with a particular reference to a group of very large and far-travelled erratics in Llanarmon parish, Denbighshire, by D. Mackintosh.—Note on the Bingera diamond-fields, by Archibald Liversidge.—Remarks on the working of the molar teeth of the *Diprotodon*, by Gerard Krefft, F.L.S.; communicated by the president. In this paper the author criticised a figure of the lower molars of *Diprotodon*, published by Prof. Owen, on the ground that the teeth are represented in it in an unabraded state, and stated that when the last tooth breaks through the gum the first of the series is always worn flat. He also remarked on the peculiar modification of the premolar in the genus *Diprotodon*.—Descriptions of species of *Chætetes* from the lower Silurian rocks of North America, by Prof. H. Alleyne Nicholson, F.R.S.E. In this paper the author accepted the union of *Chætetes* and *Stenopora* made by Milne Edwards and Haime, and stated that *Monticulipora* D'Orb. and *Nebulipora* McCoy, also seemed to him to belong to the same generic group, for which he proposed to employ the name *Chætetes*.—On the composition and structure of the bony palate of *Ctenodus*, by L. C. Miall; communicated by Prof. P. Martin Duncan, F.R.S.—Notes on a railway section of the Lower Lias and Rhætics between Stratford-on-Avon and Fenny Compton, and on the occurrence of the Rhætics near Kineton and the Insect-beds near Knowle in Warwickshire, and on the recent discovery of the Rhætics near Leicester, by the Rev. P. B. Brodie.—The resemblances of ichthyosaurian bones to the bones of other animals, by Harry Govier Seeley, F.L.S. In this paper the author endeavoured to give precision to the term ichthyosaurian by analysing the characters of the Ichthyosaurian skeleton into the resemblances which it presents to skeletons of other vertebrates. Ichthyosaurian characters are subdivided into Mammalian, Avian, Crocodilian, Chelonian, Lacertilian, Camelonian, Rhynchocephalian, Ophidian, Urodelan, Piscine, Plesiosaurian, Dinosaurian, Dicynodont, and Labyrinthodont. By thus classifying the characters it is anticipated that the affinities of the Ichthyosaurian type may be rendered evident.—The resemblances of Pleiosaurian bones with the bones of other animals, by Harry Govier Seeley, F.L.S. This paper is an attempt to make a similar analysis of the Plesiosaurian skeleton.—On the tibia of *Megalornis*, a large struthious bird from the London clay, by Harry Govier Seeley, F.L.S. The author considered that the skull named by Prof. Owen *Dasornis* might, if it belonged to a bird, be referred to *Megalornis*; but he detailed considerations which led him to suggest that *Dasornis* may possibly be a fish.—On cervical and dorsal vertebræ of *Crocodilus cantabrigiensis* Seeley, from the Cambridge Upper Greensand, by Harry Govier Seeley, F.L.S.—On the base of a large Lacertian skull from the Potton sands, by Harry Govier Seeley, F.L.S. This specimen was interpreted by the author as the anchylosed basioccipital and basisphenoid of a Dinosaur. The author did not regard the specimen as giving support to Prof. Huxley's hypothesis of the Avian affinities of Dinosaurs.—A section through the Devonian strata of West Somerset, by Harry Govier Seeley, F.L.S.—On the pectoral arch and fore limb of *Ophthalmosaurus*, by Harry Govier Seeley, F.L.S. After some remarks on the structure of the pectoral arch in *Ichthyosaurus* the author described parts of a skeleton discovered by Mr. Leeds in the Oxford clay, on which he founded the genus *Ophthalmosaurus*.—The glacial phenomena of the Eden Valley and the western part of the Yorkshire Dale district, by J. G. Goodchild; communicated by H. W. Bristow, F.R.S. This paper is a continuation, in a northward direction, of the investigation of glacial phenomena which formed the matter of a paper lately read before the Society by Mr. Tiddeman, and published in the Society's journal.—Geological observations made on a visit to the Chaderkul, Thian Shan range, by the late Dr. F. Stoliczka. In this paper the author gives an account of the geology of the district traversed by him in his journey from near Kashgar to Lake Chaderkul on the Russian frontier, a distance of about 112 miles, his route lying among the southern branches of the Thian Shan Range. Three principal ridges were crossed. The first, or "Artush ridge," consisted of newer Tertiary deposits of bedded clay and sand, mostly of a yellowish white colour. These "Artush beds" were traced by the author for a distance of 22 miles. The southern slopes of this range were covered with gravel from 10 to 15 ft. thick, which passes into a conglomerate with a thickness of about 200 ft. The second, or "Kokan range," is formed on the southern side of old sedimentary rocks, whilst the northern is occupied by newer Tertiary deposits and basaltic rocks, the former consisting of shales and limestones, in which the author found some fossils, inducing him to refer them to the Trias. These are succeeded by some dark-coloured shales, slates, and sandstones, dipping at a high angle to the north. On the denuded edges of these the new Tertiaries rest, consisting of sandstones interstratified with basaltic rocks. These latter increase in thickness till just beyond Kulja an old "somma" is reached, with perpendicular walls rising to a height of 1,500 ft. above the river. The cone of the volcano has disappeared by subsidence. The third ridge, "Terek-tagh," consists of old sedimentary rocks, chiefly limestones.—Note upon a recent discovery of tin-ore in Tasmania, by Charles Gould.—Note on the occurrence of a Labyrinthodont in the Yoredale rocks of Wensleydale, by L. C. Miall; communicated by Prof. Huxley, F.R.S. The author briefly describes a specimen, discovered by Mr. W. Horne, of Leyburn, in the Lower Carboniferous Rocks there, comprising casts of five bones. He considers that these bones belong to an animal of higher rank than any known fish, and thinks that the Lower Coal-measures of Glasgow, with *Loxomma*, may be of earlier date than the Yoredale Rocks.—Geological Notes on the route traversed by the Yarkund Embassy from Shahidulla to Yarkund and Kashgar, by Dr. F. Stolickza. The author described the rocks observed by him along the course of the Karakash river and through the Sanju pass as chiefly metamorphic, and very highly inclined, until near Yám sedimentary rocks rest unconformably on the schists. These are probably Palæozoic. Later rocks occur near the camp Kiwáz, some resembling the rocks of the Nahún group, and underlain by deposits containing Carboniferous fossils. At Sanju coarse grey calcareous sandstones and chloritic marls of Cretaceous age occur. True Löss occurs in some of the valleys.—The hematic deposits of Whitehaven and Furness, by J. D. Kendall.—Notes on the Physical Characters and Mineralogy of Newfoundland, by John Milne. Notes on the Sinaitic Peninsula and north-western Arabia, by John Milne.—Giants' Kettles at Christiania, by MM. W. C. Brögger and H. H. Reusch; communicated by Prof. Kjerulf. The authors first refer to the popular notices about giants' kettles, and describe in detail a number of these pits, which were examined and emptied near Christiania. They then mention the theory concerning their origin. From their own facts and reading they conclude that many of these remarkable pits were made at the bottom of "Moulins" during a glacial period, when the locality was covered with ice on the scale of existing ice in Greenland. The contents of these pits are traced to their parent rocks, which are higher up towards the great valley of Gulbransdal, in which glacial phenomena abound. They are inclined to conclude that moraine matter was washed off the glacier-ice from time to time, and left in the pits at last.

Geologists' Association, July 3.—Henry Woodward, F.R.S. president, in the chair.—On the deposits now forming in British seas, by G. A. Lebour, F.G.S. The author limited his present task to a brief description of the principal constituents of British sea-bottoms, with particular reference to their distribution and its causes. The materials are of mechanical, chemical, or organic origin.—*Rock-bottoms.* In some places no deposit occurs, the bare rock being left. The largest of these bare spots, in British seas, occurs in the western half of the Channel Valley. Their distribution is directly connected with that of currents, and this is strikingly proved by their being limited to no relative depth; for, in the Channel, their range extends entirely across the valley. Another bare area exists at the point where the Atlantic cable enters the yet deeper region of the Atlantic ooze in 500 fathoms water. The specimens brought up by the sounding instruments from such places consist of weathered and rotten stone, pointing to chemical rather than mechanical disintegration, even where powerful currents are present.—*Marine deposits.* These consist chiefly of sand, with occasional islands of clay, mud, gravel, and shell detritus. The broader the sea the greater the proportion of sand: thus the North Sea bottom is especially a sandy one, though towards the centre the sand becomes muddy over a considerable region. Sandy bottoms also largely prevail in the north-western seas and on the west coast of Ireland; but south of Ireland a large expanse of pure mud and muddy sand extends in a south-easterly direction.—*Organic deposits.* In the Channel the shell deposits attain their greatest development as regards British seas. There they form two long, occasionally broken lines, following at a short distance the English and French shores, and forming at the outer mouth of the Channel a vast shell bank. These deposits actually cross the broad sea-valley partly over and considerably to the west of the spread of bare rock previously mentioned. Beyond the ocean valley which lies between the Hebrides and the Rock-hall reef, there occurs a fish bank more than three miles in length, affording us an inkling of the manner in which some of our long-fossilised fish-beds may originally have been accumulated.—*Fluvio-marine deposits.* The Thames, Seine, and Tay form mud banks in a sandy sea. The submarine delta of the former has the shape of a triangle, of which the apex points seawards; that of the Seine is also triangular in outline, but the apex points landwards. Such submarine deltas can only be recognised when the materials of which they consist are distinct from those forming the prevailing sea-bottom. Although much of the above materials are at present incoherent, especially the sands, it is not probable that the larger features of the sea-bottoms are liable to important changes, whilst the surrounding geographical conditions remain unaltered. The same agencies, which sweep certain spots, have heaped-up material elsewhere, and the relative form of both covered and uncovered portions of the sea-floor is preserved by them. The points of the greatest violence of current action are shown by the bare rock patches, whilst the intermediate stages of agitation are represented by coarse shingle, sandy gravel, sand, and finally patches of mud or clay supervene, which, to a certain extent, indicate centres of calm.

Entomological Society, July 6.—Sir Sidney Smith

Saunders, president, in the chair.—Prof. Westwood exhibited specimens of *Haltica aurata*, which he had found to be very injurious to young rose-leaves. Also, a portion of a walnut attacked by a Lepidopterous larva, probably a Tortrix; but he was unable to name the species, as it produced only an ichneumon. It was the first instance he had known of a walnut being attacked by an insect in this country. Mr. F. Moore stated that he had on one occasion reared *Carpocapra splendana* (a species that usually feeds on acorns) from a walnut.—Prof. Westwood made some remarks on the Yucca moth (*Pronuba yuccasella* Riley), of which some fifty specimens had been sent to him, in the pupa state, by Mr. Riley; but he had succeeded in rearing only three. He exhibited a drawing of a portion of the insect, showing the extraordinary form of the pulpi, which was especially adapted for collecting the pollen, with which it impregnated the female flowers. He directed attention to a full description of the insect and its habits by Mr. Riley, in the sixth Annual Report of the Insects of Missouri.—Prof. Westwood also exhibited some bees which had been sent to him from Dublin, having been found attacking the hives of the honey-bees. They were smaller than the honey-bee, and black, and he considered them to be only a degenerated variety of *Apis mellifica*. He suggested the probability of their being identical with the "black bees" mentioned by Huber.—Mr. Champion exhibited *Amara alpina* and other beetles from Aviemore, Invernesshire.—The Secretary exhibited some specimens of a Dipterous insect which had been found in the larva state in an old Turkey carpet. The larva was very long, slender, and serpentiform; it was white and shining, and had something the appearance of a wire worm, but much longer, and without feet. The name of the insect was not ascertained.—Mr. Bond exhibited specimens of *Argas pipistrellæ* parasitic on a bat, and also some *Acari* from a small species of fly; both were from the Isle of Wight.—Mr. Boyd exhibited specimens of *Thecla rubi* from St. Leonard's Forest, differing in certain points from the ordinary type.—Mr. Wormald exhibited a collection of butterflies sent from Japan by Mr. H. S. Pryer.—Mr. W. Cole exhibited some galls of a species of *Cecidomyia*, found in West Wickham Wood.—Mr. F. Smith exhibited some earthen cocoons found on wet mud at Weymouth by Mr. Joshua Brown. They proved to belong to a Dipterous insect (*Machærium maritimum*), one of the *Dolichopidæ*.—Mr. S. Stevens exhibited specimens of *Asopia nemoralis* from Abbot's Wood, Lewes, and other Lepidopterous insects.—Mr. Butler exhibited a copy of a very rare (if not unique) book, which had recently come into the possession of Mr. E. W. Janson, entitled Lee's "Coloured Specimens to illustrate the Natural History of Butterflies" (London, 1806). He could not find that it had been quoted in any synonymic catalogue, and it contained coloured drawings and diagnoses of nineteen species of butterflies.—The Rev. H. S. Gorham read descriptions of species of Endomycid Coleoptera not comprised in his catalogue, "Endomycici recitati." Also, Some remarks on the genus *Helota* (*Nitidulidæ*), of which he described a new species from Japan.—Dr. Sharp communicated a supplementary paper On some additional Coleoptera from Japan.—Prof. Westwood communicated Descriptions of new species of *Cetoniidæ*, principally from the collection of Mr. Higgins.—The President announced that the library of the Society would remain for another year at 12, Bedford Row, and it was hoped that by that time some more permanent and suitable place would be obtained for it.—Part III. of the Transactions of the Society for 1874 were on the table.

PARIS

Academy of Sciences, July 13.—M. Bertrand in the chair.—The perpetual secretary announced the death of M. Angström, and the president made some remarks expressive of the regret of the Academy at the loss they had sustained. The following papers were read:—Observations relating to M. Tacchini's last note and to the recent memoir of M. Langley, by M. Faye. The author gave an extract from Langley's memoir, showing that this observer accepted, with certain restrictions, the cyclone theory of sun-spots.—On chemical actions other than metallic reductions produced in capillary spaces, by M. Becquerel. This is a continuation of the author's researches in electro-chemistry.—Observations on the subject of the establishment of an inland sea in Algeria, by M. de Lesseps.—Memoir on the chronological classification of geological formations, by A. E. B. de Chancourtois.—On some applications of Abel's theorem to curves of the second degree relative to the elliptic functions, by M. H. Léanté.—On the observation of a phenomenon analogous to that of the "*goutte noire*," by M. Devic.—Observations on the obstacles to be opposed to the attack of vines by Phylloxera, a letter from M. Bourgeois to M. Dumas. The writer made four propositions relating to (1) the direct destruction of the insects; (2) the preservation of isolated stocks; (3) the preservation of a field of vines not attacked; and (4) treatment of a field partially attacked. Several members made remarks on the same subject. M. Elie de Beaumont suggested the use of snow.—Note relating to the *viriel* of M. Clausius, by M. F. Lucas.—Note relating to the theory of osculatory surfaces, by Mr. Spottiswoode.—Remarks on the pyrheliometric observations of Pouillet, a reply to the criticisms of M. Faye, by M. Duponchel.—On chemical achromatism, by M. Prazmowski. This was a note descriptive of the construction of the photographic objective to be used by M. Janssen for photographing the solar disc.—Second note on the electric conductivity of ligneous bodies, by M. Th. du Moncel.—On indications furnished by conjugate thermometers *in vacuo*, by M. Marié-Davy.—Qualitative research on arsenic in organic and inorganic substances, by MM. Mayençon and Bergeret. The authors have devised a new plan for detecting arsenic (depending upon the action of arsenetted hydrogen on mercuric chloride), which possesses extreme delicacy.—Action of heat on the isomers of anthracene and their hydrides, by M. Ph. Barbier. The author has extended his investigations to the following substances:—the two ditolyls, ethylene and diphenyl mixed, and benzyltoluene. Fritzsche's phosene appears to have been a mixture of anthracene and phenanthrene.—New experiments on human locomotion, by M. Marey.—New experimental researches on inflammation and mode of production of leucocytes of pus, by M. J. Picot. Action of salts of biliary acids, by MM. V. Feltz and E. Ritter.—Observations on the first phases of development of *Pelobates fuscus*, by M. G. Moquin-Tandon. These phases are in the main identical with those of the common toad.—Analyses of the samples of wine exhibited at the exhibition of the Pavillon du Progrès, by M. Ch. Mène.—On globular lightning, by M. Gaultier de Claubry. This was a description of some of the effects of the thunderstorm which broke over Paris on Thursday the 9th inst.

BOOKS RECEIVED

AMERICAN.—Baird's Annual Record, 1873.—Proceedings of the Boston Society of Natural History, vol. xvi. part ii.—Field Ornithology, comprising a Manual of Instruction for procuring, preparing, and preserving Birds, and a Check List of North American Birds: Dr Elliott Coues, U.S.A. (Trübner).—The Birds of Florida, Part iii.: C. J. Maynard (Ipswich, U.S.A.).—Bulletin of the Buffalo Society of Natural Science (Warren & Co, Buffalo)—Circles of Deposition of American Sedimentary Rocks: J. S. Newberry.—Theory of Arches: Prof. W. Allan (Van Nostram, N.Y.).—My Visit to the Sun; or, Critical Essays: Laurence S. Benson (J. S. Burton, N.Y.).—Annual Report of the Trustees of the Museum of Zoology, Harvard, Camb. U.S.A. for 1873—Birds of Western and North-Western Mexico: G. A. Lawrence (Boston Natural History Society).—The Organisation and Progress of the Anderson School of Natural History (Welch, Biglow & Co., Camb. U.S.A.).—Sea Fisheries of the South Coast of New England: Spencer and Baird (Washington).—The Vertebrate Animals of Vineyard Sound: A. E. Verrill and S. J. Smith (Washington).—First, Second, and Third Annual Reports of the United States Geological Survey of the Territories for 1867-69 (Washington).—Geological Survey of Ohio, vol. i. Palæontology (Columbus).—Reports of the Geological Survey of Missouri, 1855-71 (Jefferson City).—Reports of the Geological Survey of Missouri Iron Ores and Coalfields, 1872 (N.Y.)—Atlas to Geological Survey of Missouri (N.Y.).

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THURSDAY, JULY 30, 1874

JOSEPH PRIESTLEY

DURING the present week the centenary of the birth of Modern Chemistry, as the discovery of oxygen on August 1, 1774, may justly be called, is being celebrated both in this country at Birmingham and Leeds, and in America at Northumberland, Pennsylvania; we have therefore thought it would be acceptable to our readers to be reminded of the principal events in the life of the author of this all-important discovery.

Joseph Priestley was born on March 13, 1733, at Fieldhead, near Leeds. At the age of six years he lost his mother, and his education was superintended by Mrs. Keighley, his aunt, a woman apparently of unusually wide sympathies. At an early age young Priestley distinguished himself at school by his great aptitude for learning languages; he was familiar with Chaldean, Syriac, and Arabic, and without the aid of a master acquired some knowledge of German, French, and Italian. A pupil of Maclaurin taught him mathematics. He took great interest in theological controversies, and his aunt's tastes provided him with many opportunities of gratifying his liking in this matter. Having studied for the Dissenting ministry, he was called to be minister of a small Unitarian congregation at Needham Market, in Suffolk, in 1755. Here he remained until 1758, when he went to occupy a similar post at Nantwich, in Cheshire. Here he opened a school, and by dint of rigid economy was able to buy some physical apparatus, with which he made, to his young pupils, a series of experiments that drew upon him the notice of the authorities of the Warrington Academy, so well known in connection with the name of Aikin. In 1761 he went to this Academy to take Dr. Aikin's place as teacher of languages and literature, and soon after married the daughter of a Welsh ironmaster. While at Warrington he published a number of works on various subjects, including the "Theory of Language and Universal Language" (1762-68), "Essay on a Course of Liberal Education for Civil and Active Life" (1765), "Chart of Biography" (1765), Chart of History" (1769), &c. A visit which he made to London during this period gave him the opportunity of forming a lasting friendship with Franklin and Price. He communicated to the former his intention of writing a history of discoveries in the department of electricity; and not only did he receive from Franklin a warm approval of the scheme, but also all the books and memoirs he required; and before the end of the year, by dint of persevering work, the first volume was published, under the title of "The History of Electricity" (London, 1764, 4to). Three editions of this were published by 1775; but it bears evident marks of having been written in haste.

Previous to the publication of this work, in 1766, Priestley was chosen a Fellow of the Royal Society, and about the same time the University of Edinburgh conferred upon him the honorary degree of LL.D. In the same year as the above-mentioned work was published, Priestley left Warrington and became pastor of Mill-hill Chapel, in Leeds. While here he was much occupied with theological controversies, but by no means neglected his scientific studies, as about 1768 his attention was drawn to chemistry, the result being that in 1772 he communicated to the Royal Society a paper entitled "Observations on different kinds of Air," for which the Copley Medal was awarded to him.

Meantime, Priestley had received an offer to accompany Capt. Cook on his second expedition to the South Seas; this he accepted gladly, but received an intimation that his nomination had not been confirmed by the Board of Longitude on account of his advanced theological opinions. In 1773, however, at the recommendation of his friend Price, he was appointed librarian to the Earl of Shelburne (afterwards Marquis of Lansdowne) at a comparatively liberal salary. In the following year, he accompanied this nobleman into France, Germany, and the Low Countries. At Paris his scientific reputation easily procured him the acquaintanceship of well-known men of science. Besides his salary, Lord Shelburne allowed him expenses for a laboratory, and it was on Aug. 1, 1774, that he made the discovery which marks so important an epoch in the progress of chemical science, and the centenary of which is being celebrated both in England and in America during the present week. The discovery was that of oxygen gas, which he announced in his "Experiments and Observations on Air," the first volume of which was published in 1774.

For some unexplained reason, Priestley and Lord Shelburne parted in 1780, the latter covenanting to allow the former till his death a pension of 150*l*. Priestley then settled in Birmingham, to which he was attracted, no doubt, by the prospect of meeting with men of kindred scientific tastes. Here he was chosen pastor of one of the principal Dissenting churches, his friends subscribing to defray the expenses of his scientific experiments and his theological controversies, for he was regarded as one of the greatest controversialists of his age. His opinions both on ecclesiastical and political topics were much ahead of his age; but this is not the place to enlarge on this aspect of the character of this remarkable man. We may only mention that he was brought forward as a candidate for the French National Convention, and was nominated a French citizen, a title of which he was very proud. For his unconcealed liberality and advanced opinions he was doomed, however, to suffer, as the populace of Birmingham, roused to a state of blind fury by the partisans of Government, rushed to Priestley's house, July 14, 1791, and set fire to it, reducing it and nearly all it contained to ashes. However, as the result of an examination, Priestley subsequently received an indemnity of 2,000*l*. for this mad act, this sum being considerably increased by the liberality of his private friends.

Although no word of complaint escaped Priestley concerning this misfortune, it no doubt influenced him to a considerable extent in deciding him to quit his native land for republican America. After spending three years in a college at Hackney, as Professor of Chemistry and minister, he embarked on April 7, 1794, and fixed his residence at Northumberland, in Pennsylvania. Even here it was some time before he was allowed to remain at peace, as a spiteful rumour had been circulated that he was a secret agent of the French Republic. Here he lost his wife and his youngest son, and here he himself died on Feb. 6, 1804.

Turning now from the external aspects of Priestley's life, let us consider the position he held as a philosopher and the influence that his discoveries had on the science of his time. The ever-memorable discovery of "dephlogisticated air" on Aug. 1, 1774, marks an epoch in the annals of chemistry with which the name of Dr. Joseph Priestley will be always associated. He obtained it by exposing a quantity of red precipitate of mercury to the action of the sun's rays concentrated upon it by a lens; the red precipitate was contained in a flask filled up with mercury and inserted in a basin containing the same metal. "I presently found," he says, "that by means of this lens air was expelled from it very readily. Having got several times as much as the bulk of my materials, I admitted water to it, and found that it was not imbibed by it; but what surprised me more than I can well express, was that a candle burned in this air with a remarkably vigorous flame, very much like that enlarged flame with which a candle burns in nitrous air exposed to iron or lead of sulphur; but, as I got nothing like this remarkable appearance from any kind of air besides this particular modification of nitrous air, and I knew no nitrous acid was used in the preparation of *mercurius calcinatus*, I was utterly at a loss how to account for it." He then goes on to show that red lead and nitre also afford oxygen at a red heat, and calls it, consistently with the theory of combustion which was then prevalent, *dephlogisticated air*, regarding it as common air deprived of phlogiston, and consequently possessed of a powerful affinity for that imaginary principle.

This discovery, however, though unquestionably brilliant, must not be allowed to eclipse those other numerous and valuable contributions to science with which this indefatigable worker enriched the stores of natural knowledge during a period ranging from 1768 to 1800. There are indeed few branches of natural science which did not reap some benefit, direct or indirect, from the discoveries of the experimenter whose memory we now recall.

On the 17th of August, 1771, Priestley enclosed a sprig of mint in air in which a taper had been allowed to burn out, and he found on the 27th of the month that the same air then permitted the combustion of another taper with perfect facility. Thus was the secret of vegetable respiration first made known. In the discoverer's own words: "This restoration of air I found depended upon the vegetating state of the plant, for though I kept a great number of the fresh leaves of mint in a small quantity of air in which candles had burned out, and changed them frequently for a long space of time, I could perceive no melioration in the state of the air." In pneumatic chemistry (of which the germs had been originated by Black, Mayow, Hooke, and Hales), Priestley found a new engine of research, and in his hands this *Οργανον* yielded vast results. His productions in pure chemistry are too well known to be discussed fully here, even did space permit. In addition to oxygen he discovered nitrous oxide (1776), sulphurous anhydride (1774), ammonia gas (1774), carbonic oxide and hydrochloric acid gas (1772): he was also the first to investigate the properties of nitric oxide. We may point to nitrous oxide *en passant* as one of the many instances in which pure science has furnished a substance of practical utility to man: the discoverer of "dephlogisticated nitrous air" little dreamt that the lapse of a century would see this substance used as an anæsthetic for the purposes of dentistry. The pneumatic and mercurial troughs, now indispensable parts of our laboratory "plant," were also bequeathed to us by the philosopher of Fieldhead. Although chemistry received the greater part of Priestley's attention, other branches of science, as before stated, received the benefit of his thoughts. Thus we find a work by him bearing the date 1772, entitled "The History and Present State of Discoveries relating to Vision, Light, and Colours," and we have already referred to his "History of Electricity." From a catalogue of Priestley's works, printed at the end of his "Experiments and Observations relating to various branches of Natural Philosophy," we find that this extraordinary man was the author of no less than thirty-six volumes on various subjects; among others, the theory and practice of perspective, charts of history and biography, rudiments of grammar, observations on education, a course of lectures on oratory and criticism, an essay on the first principles of government, and on the nature of political, civil, and religious liberty, together with large numbers of works on metaphysical subjects and on theology.

But it is with the *chemical* aspect of Priestley's life that we are more particularly concerned at present. The anniversary about to be celebrated is that of a purely chemical discovery, and one which to us appears doubly important, first, from the great flood of light which it shed on the processes of combustion and of respiration, both animal and vegetable, aërial and aquatic; and secondly, from the powerful illustration which it affords of the value of a new method in scientific investigation. The purely practical results which in after years flowed from the discovery of oxygen, such, for example, as the oxy-hydrogen blowpipe, which enables large quantities of platinum and of the most refractory metals to be smelted with ease, are at present of minor interest. Is it not this over-anxious regard for "practical results" that has led to the complaints, too frequently made, about the decline of chemical research in England? The spirit of the old investigators of the school of Priestley, Cavendish, and Black seems to be forsaking us, and, with certain exceptions, our most efficient workers are devoting their time and energies to effecting permutations and combinations among the elements—in seeing in how many ways certain atoms of carbon, hydrogen, and oxygen can be combined, or in locating atoms to certain imaginary positions in space. It must not be for a moment supposed that we advocate the entire cessation of this kind of work—it is useful in its way as supplying facts, but by itself it is not sufficient to lead us to hope for any great advancement in our knowledge of chemical laws. The greatest advancements in chemistry have been the results of the application of *physical* discoveries—witness the vapour-density control for the formulæ of compounds and the atomic weights of the elementary gases; or the determination of specific heat as a means of controlling the atomic weight; or turn again to that great engine of modern research, the spectroscope, which has enabled us to extend our list of known elements, and which reduces the chemistry of this globe and of suns infinitely remote to one common basis. So also is isomorphism an essentially physical phenomenon and one for the explanation of which we shall doubtless be hereafter indebted to physics. The Newton of chemistry may be looked for in the ranks of physicists. In the meantime let us only hope for "new methods" of research—let investigators seek for some method bearing the same relation to our chemistry that the "pneumatic chemistry" of Priestley did to that of his time.

ON TESTIMONIALISM

JUST now, there must be several scientific men asking themselves what can be the conceivable value of testimonials in determining the relative fitness of a number of candidates for any appointment of such importance as a Professorship of a most important branch of natural science in a great seat of learning.

It is not a point of any great difficulty to determine, to one's mental satisfaction, in what cases testimonials are of value – for they are sometimes most useful—and when they are worthless in comparison to other methods for testing the relative efficiency of different men.

Testimonials, or an examination, or the two combined, are no doubt necessary, when the post to be competed for is one, the qualities required for which are not capable of being exhibited to an electoral body by the competitors in any other way. For minor appointments, therefore, such as clerkships, smaller educational posts and the like, they are indispensable; as they are in cases where the intimacy of the relationship between the holder of the post and those he is placed above is close. But for appointments so honourable and responsible as the Professorship of Physiology in the University of Edinburgh, or that of Chemistry in the University of Glasgow, we cannot help thinking that testimonials are a farce. Candidates for such chairs are not youths; they must have had the opportunity of maturing their minds by careful training, during which time frequent opportunities must have occurred for them to take up some fresh branch of their subject and work it out independently, with some originality in the methods they employ. Their confidence in their methods and results ought to have been sufficient to make them publish them, and so expose them to the criticism of the scientific public, who do not generally take long to form a fairly correct estimate of the abilities of authors. If all candidates for important posts were compelled to rely for their election on their works alone as testimonials, we are sure that the electors would be less trammelled, and more in a position to make judicious selections.

By some it may be remarked that what is wanted in the cases above instanced is good teachers, and that if men with original power can be obtained at the same time, so much the better; this requirement makes the general ability of the professor a secondary consideration in comparison with his teaching powers. We are of opinion that this is a mistaken view of the subject. Very frequently the most talented followers of scientific inquiry are not such effective lecturers at first sight as their less-gifted colleagues; still, we never knew a case in which there was not a peculiar charm about the teaching of a master-mind that gives an impulse to study on the part of the student, producing in the long run more beneficial results than the routine discourses of a mere expositor of other people's work. Another thing is that the connection of great names with a seat of learning in itself gives a stimulus to younger workers, raising success in mental work to a position which it is not easy for it to attain, on account of the fact that its results have frequently no immediate practical bearing.

In one at least of the cases we are referring to it is unfortunate in some respects that the electors have no special interest in the science they have so great a power indirectly to advance. In consequence of this their knowledge of the respective merits of the candidates must be uncertain, and we do not think that it will be much increased by the showers of testimonials which it is evidently the intention of more than one of the candidates to submit. One candidate has sent broadcast a lithographed form, sometimes even to men his junior in position and age, courting testimonials. What possibly can be the value of the pound's weight of paper he will probably thus accumulate? He ought to remember that no number of shots from a smooth-bore gun will send a ball as far as a single one from an Armstrong, and on that principle reduce the number and endeavour to increase the quality of the testimonials he sends in; by which means he will save the adjectives as well as the temper of his acquaintances.

Another candidate sends us the printed list of his published works, and to that we see no particular objection. But appended to each is a selected series of reviews, from which all the unfavourable ones are carefully omitted. It is, no doubt, unpleasant to print adverse criticism, but how can the electors be expected to form a correct estimate of the value of the works reviewed, if those in their favour only are introduced? The reviews, as one-sided, had been much better omitted, or, if printed, had much better have been inserted without selection. It is this extreme mode of action thus adopted which has called our attention to the subject.

On the whole, we think that the electors for the Scotch Science Chairs have a by no means easy task before them, and we sincerely hope that in their selection they will lay stress on soundness of judgment and scientific thought rather than on quires of testimonials wrung out of acquaintances and friends, who would much rather have been otherwise employed than in putting pen to paper for the purpose.

Moreover, we are of opinion that not only should a man's researches be taken into account in making an appointment to any science chair, but also that no election should be made without taking the opinion of those competent to form an estimate of the value of these researches.

THE RAINFALL OF BARBADOS

Report upon the Rainfall of Barbados, and upon its influence on the Sugar Crops, 1847-1871. With two Supplements, 1873-74. By Governor Rawson, C.B.

THIS Report gives the result of observations made since 1847, at a large number of stations well distributed over the island. The total area of Barbados is 166 square miles; in 1847, only three stations had been established, in 1873 there were 178, so that at present there is more than one gauge to every square mile. By this system the conditions of local rainfall have been, as it were, put under the microscope; and the store of information obtained after the suggestive manner in which it has been analysed in this Report, will be not only valuable to the sugar-planter, but interesting to the meteorologist.

The north-east trade-wind prevails at Barbados during three-fourths of the year, and most of the rain comes from that quarter. Heavy showers come at certain seasons from south-west and north-west, but generally fail to reach the eastern districts. Indeed it very rarely happens that rain falls at the same time, or in equal proportions, over the whole island; it has, therefore, been divided into two main districts, the windward, and chiefly highland, and the leeward, or lowland section.

With regard to the yearly rainfall of the whole island from 1847 to 1871, it has been found, among other results (1), that the rainfall of fifteen years was above the mean, that of ten years below it; (2) that the deficiencies were generally greater than the excesses above the mean, that is, droughts, when they happen, are heavy; (3) that, taking the thirty years 1843-72, no succession of wet or dry years in cycles can be traced, but rather an alternation of wet and dry years. No more than two dry years have occurred together, but as many as three and four wet years.

With regard to the monthly rainfall: the mean of all the months is under 5 in.; March is driest, October wettest. In wet years May contributes most to the excess, March least. March is the only month of which the mean rainfall in dry years has exceeded the average. In dry years the deficiency is generally spread over the whole year; in wet years the excess is generally confined to the rainy season (autumn). On the other hand, taking the seven wettest and the seven driest years of the period, we observe that in the wet years two-thirds of the excess proceeds from heavy rains in the dry season, and that in the dry years more than two-thirds of the deficiency is caused by three out of the same four months, viz. June, July, and May, and by October and May.

A comparison between the three highest and the three lowest rainfalls belonging to each month during the whole period of twenty-five years shows a remarkable uniformity of the relation between the percentages of the extremes; thus the difference between each average of the lowest months and each average of the highest amounts in none of the twelve months to more than 90 (May) or less than 65 per cent. (August and September).

Of the two stations, Binfield and Halton, lying respectively at 1,065 and 280 ft. above the sea, the former received on an average nearly 11 in. more rain in the year, and showed a greater monthly variability. The influence of elevation is interesting. A table of rainfall in 1870 and 1871, at various heights from 100 ft. up to 1,000 ft., shows an increase at every step of 100 ft. but one, and the total increase at 1,000 ft. amounts to 20·73 in. on the mean of two years. Two exceptions to this regular increment in the means for 1871-73, in supplement No. 2, are ascribed to the lower stations catching the westerly rains, which do not penetrate far inland.

In March, one-half more rain fell at night than by day. From June to November, the days are slightly the wetter, from December to May, the nights.

One of the objects of this inquiry is to assist those who are interested in calculating the character of coming seasons. For such a purpose the annual averages of, each month are taken, after eliminating the exceptional months of very great or of very slight rainfall. The original averages are not affected more than 6 per cent. by this removal. Having the ordinary limits of monthly rainfall tabulated, and observing the general appearance of the weather, every planter can form *some* conjecture whether the coming month will be wet or dry.

Appendix No. 36 shows the influence of each month according to the rainfall, upon the crop of the same year, and upon that of the following year. Thus a man might fairly bet 9 to 3 that a wet February will be followed by a bad crop, and 8 to 1, the highest odds of all, that a wet September will give a good crop next year.

A wet year is followed almost invariably by a good crop in the following year; and it is found that by multiplying the total rainfall of the preceding year by 800 and adding 7½ per cent. if that year was a dry one, or subtracting 7½ per cent. if that year was a wet one, the crop may be calculated in most instances within 3,000 hhds., the average yield of the island being 45,000 hhds. The good chance of predicting so nearly the total exports of Barbados for the coming year cannot fail to be of value, and further experience will no doubt reduce the probability of error. Let us hope that other States may be led to undertakings of the same kind by this example.

F. A. R. RUSSELL

OUR BOOK SHELF

Manual of British Botany, containing the Flowering Plants and Ferns arranged according to Natural Orders. By C. C. Babington, M.A., F.R.S., F.L.S. Seventh Edition; corrected throughout. (London: J. Van Voorst, 1874).

WE cordially welcome this new edition of a "Manual of British Botany" which continues to hold its ground against all its competitors. We do not propose to discuss the rival merits of Hooker's, Bentham's, and Babington's hand-books; each has specialities in which the others are wanting; and each will, no doubt, long have its advocates and admirers. A special claim to popularity as a *field-book* is advanced by the present work on the ground of its portability; and a great advantage is alleged by those who use it to be presented by the practice of placing in italics a few words in the description of each species referring to the character by which it is more readily distinguished from its nearest allies. Comparing the work with the most recent of the earlier editions which we have at hand—the 4th, published in 1856—we find that it extends only to twenty-six pages more, notwithstanding the numerous additions made since that time to British botany, of which ample account has been taken in the present edition. The only alteration made in the primary classification (comparing these two editions) is the separation of Cannabinaceæ from Urticaceæ. The number of natural orders is six more than in Hooker's "Student's Flora," notwithstanding the union of Salicaceæ, Myricaceæ, Betulaceæ, and Cupuliferæ into the somewhat artificial group of Amentiferæ. The location of individual genera has also been in some cases revised, as the removal of *Narthecium* from Juncaceæ (Babington, 4th ed.) or Liliaceæ (Hooker) to Melanthaceæ. Referring to some of the more difficult genera, in which Prof. Babington is an acknowledged authority, we find the number of species of *Rubus* increased from 41 to 45, while that of *Rosa* is reduced from 19 to 11, and of *Salix* from 32 to 29. We have never been able to understand on what principle Characeæ find a place in a work devoted to "Flowering Plants and Ferns," by the latter term being apparently meant Vascular Cryptogams. Prefixed to the work is a useful Glossary not found in the earlier editions; but the author has wisely refrained from acceding "to the wishes of some young botanists by prefixing a short Introduction to Botany." With the numerous admirable works now at their disposal, students ought to have no difficulty in making themselves acquainted with the Flora of the British Islands. A. W. B.

Eclipses, Past and Future, with General Hints for observing the Heavens. By the Rev. S. J. Johnson, M.A., F.R.A.S., Rector of Upton-Helions, Devon. (Parker, 1874).

THIS little book is a combination of two distinct treatises; one a description of past and future eclipses; the other, a catalogue of celestial objects falling within the range of such small telescopes as amateurs frequently possess. Each of these, it seems, was originally of greater bulk, and intended for separate publication, but they have now been condensed into a single small volume. This has the merit, not very common in these days, of being more than a mere compilation; the ancient eclipses, including those in the "Saxon Chronicle" (of which the author tells us no description has hitherto been published), having been approximately computed for the purpose from the tables in the "Encyclopædia Britannica;" and the notices of the planets, double stars, &c., being derived from actual observation. The book is pleasantly written, and without professing to go deeply into the subject, may well find readers among those who feel a general interest in astronomy, but have no intention of making it matter of serious or accurate study, or of going much beyond the limits of a 2½ in. telescope. It would have been improved (without departing from its sketchy character) by a little more fulness and explicitness of treatment in some places; for instance, in the description of the belts and satellites of Jupiter, and where the abbreviated symbols of the Palermo Catalogue are left unexplained. Some misprints, too, have escaped in the revision. The following extract may interest our readers:—"For those who have very large telescopes, and who are not disposed to take them to oriental climates, it would be useful to have records of the number of clear nights in different parts of the kingdom. By clear nights, let us understand nights cloudless, or nearly so, till 11 P.M., or else clear for a full hour or two. Formerly my observations were taken in South Lancashire, but since the early part of 1870 in Devonshire. In 1859, the number of nights clear, partly or throughout, was 60; in 1860, 43; in 1861 and 1862, 46 each; in 1863, 47; in 1864, 83; in 1865, 82; in 1866, 77; in 1867, 55; in 1868, 62; in 1869, 58; in 1870, 112; in 1871, 98; in 1872, 90; in 1873, 82."

The Human Eye. By W. Whalley. (London: J. & A. Churchill.)

IN this small work the author tells us that he has incorporated the substance of a lecture on the subject, together with additions in various directions. He discusses, in a popular manner, the eye in man, and adds many facts with regard to its structure in other animals. His remarks are mostly anatomical, and we are disappointed to see so little notice of many physiological phenomena connected with the power of sight, which bring out the beauty of the organ of vision in a way which can be understood by the most amateur of readers. There is a want of consecutiveness in many of the paragraphs and chapters, though as a whole the book is a very readable one. Many of the instances given are wanting in grasp; for instance it is remarked that "In some of the ichneumons or 'Pharaoh's rats,' as the Egyptians call them, in the coatimundi, which somewhat resembles the racoon, and in the mangre, the osseous orbital ring is incomplete, and in a group of minor quadrupeds, entitled the Hyracidæ, the malar, or cheek bone, constitutes a perfect orbital ring." It is well known that the orbital ring is complete in all the Quadrumana and many Ungulata, and that it is absent in most other mammals; why then take the particular examples, which are not particularly good ones, and lay special stress on them. The deductions drawn are of a strongly teleological nature, and we cannot do better than recommend the author's reperusal of his work for the refutation of one of his concluding remarks, namely, that "In reviewing this very imperfect and disconnected sketch of the structure of the eyes of the different classes of animals, we cannot fail to recognise the fact that the human eye far transcends, both in mechanism and power, that of every other animal." We however deduce that the condor can see further, that many animals have an extra eyelid, and some bigger eyes than man himself, showing that his is inferior instead of superior in many respects.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Early Contributions to Spectrum Photography and Photo-chemistry

1. MY first attempt at photographing the fixed lines of the spectrum was made in 1834. It was on paper covered with silver bromide. As mentioned in the *Philosophical Magazine*, May 1843, it proved to be a failure. In the summer of 1842, simultaneously with M. Becquerel, by using daguerreotype plates, I succeeded, and in the following March sent a drawing of the photograph to the *Philosophical Magazine*, which was published in May. At that time I did not know that M. Becquerel was experimenting in the same direction.

The great lines α, β, γ, less refrangible than the rest, and which M. Lamansky has recently re-detected by the aid of the thermo-multiplier, are given in that drawing. These in the diffraction spectrum must be bands of very considerable width.

2. Sometimes a person is deprived of fair credit for his labour by what may be termed public perversity. I experienced this in the case of the chlorine and hydrogen photometer. The principle of this instrument is, that chlorine and hydrogen obtained in equal volumes by the electrolytic decomposition of hydrochloric acid, are made to reunite by exposure to light. I described a simple instrument of the kind in the *Philosophical Magazine* for December 1843. It still remains the most sensitive f all photo-o meters. Twelve years subsequently, Professors Bunsen and Roscoe modified it, and used it in their photo-chemical researches. In their memoirs, published in the Transactions of the Royal Society, they give full credit for the invention to me, and remark that by its use I had "succeeded in establishing experimentally some of the most important relations of the chemical action of light." They did justice in the matter, but not so the public. The instrument currently passes as their invention, not mine.

While speaking of photometers there is another to which I may allude. It depends on the principle that a solution of ferric oxalate is decomposed with evolution of carbonic acid on exposure to light. The carbonic acid may be measured or weighed by any of the ordinary methods. I described such an instrument in the *Philosophical Magazine*, Sept. 1857. Quite recently M. Marchand has published in his *Annales de Chemie* several experiments by its use, evidently unaware that it had been employed by me many years ago.

3. In 1843 I made photographs of the diffraction spectrum formed by a grating both by reflection and transmission, and published drawings of them. An account of this may be seen in the *Philosophical Magazine* June 1845 and March 1857. These were the first diffraction photographs ever made. They therefore preceded those of M. Mascart by many years. Of course they were not at all comparable with the very fine ones obtained recently by my son, Dr. Henry Draper.

4. In my memoir "On the production of light by heat" (Phil. Mag., May 1847), I established experimentally the following facts:—

(1) All solid substances and probably liquids become incandescent at the same temperature.

(2) The thermometric point at which some substances become red hot is about 977 Fahrenheit degrees.

(3) The spectrum of an incandescent solid is continuous; it contains neither bright nor dark fixed lines.

(4) From common temperatures nearly up to 977 F., the rays emitted by a solid are invisible. At that temperature they are red, and the heat of the incandescing body being made continuously to increase, other rays are added, increasing in refrangibility as the temperature rises.

(5) Whilst the addition of rays so much the more refrangible as the temperature is higher is taking place, there is an augmentation in the intensity of those already existing.

This memoir was published in both American and European journals. An analysis of it was read in Italian before the Royal Academy of Sciences at Naples, July 1847, by M. Melloni, which was also translated into French and English.

Thirteen years subsequently M. Kirchhoff published his celebrated memoir "On the relations between the coefficients of emission and absorption of bodies for light and heat." A translation of this memoir may be found in the *Philosophical Magazine*, July 1860.

In this memoir, under the guise of mathematical deductions, M. Kirchhoff, taking as his starting-point the condition discovered by Angström in 1854, respecting the relations between the emitting and absorbing powers of different bodies for light and heat, among other things deduces the following facts. I give them as they are succinctly stated by M. Jamin in his "Cours de Physique de l'école Polytechnique" (1869).

(1) All bodies begin to be red-hot at the same moment in the same space, and become white-hot at the same time.

(2) Black bodies begin to emit red rays near 525 C. (977 F.)

(3) The spectrum of solids and liquids is devoid of fixed lines.

(4) The rays first emitted by black bodies are red; to these are added successively and continually other rays, increasing in refrangibility as the temperature rises.

In his celebrated memoir, and in subsequent publications on the history of spectrum analysis, M. Kirchhoff abstains from drawing attention to the coincidences I am here pointing out, except that in a foot-note to his memoir he makes in a single word allusion to mine. But from this no one would infer what were really the facts of the case, and accordingly in the bibliographical lists subsequently published, in works on spectrum analysis, such as those of Prof. Roscoe and Dr. Schellen, my memoir is not noticed.

I earnestly solicit those who take an interest in the history of spectrum analysis to compare my memoir in the *Philosophical Magazine*, May 1847, with those published by M. Kirchhoff thirteen years subsequently, on the radiating and absorbing powers of bodies (Phil. Mag., July 1860), and on the history of spectrum analysis (Phil. Mag., April 1863).

JOHN WILLIAM DRAPER

University, New York, July 8

Sounding and Sensitive Flames

In NATURE, vol. x. p. 223, Prof. Herschel describes some experiments recently made at the Newcastle College of Science, whereby sonorous vibrations are produced in tubes by means of heated wire-gauze instead of the ordinary gas flame. Interesting as are these experiments, they are, however, by no means new. The influence of heated wire-gauze in giving rise to vibrations of air within tubes was, I believe, first published by Prof. Rijke of Leyden. In Kœnig's catalogue for 1865, Rijke's tube is advertised (No. 27) and the method of experiment described. The readiest way of making the experiment is to cut a piece of the ordinary fine iron-gauze to the size of a sixpence or shilling, and press it some three inches up a glass tube of corresponding bore. Almost any length of tube over one foot may be employed, so that notes of varying pitch can be obtained. The gauze is easily heated by a little alcohol flame at the end of a bit of quill tubing. Employing platinum-gauze heated by an electric current, or a gas flame resting above the gauze, the sounds can be rendered permanent. By one or other of these methods no doubt many of your readers have, like myself, often repeated this experiment during the last six or seven years.

I notice also that Prof. Herschel has kindly attributed to me a modification of the ordinary sensitive flame; the credit of this belongs to Mr. P. Barry, of Cork. This arrangement simply consists of a sensitive flame burning on wire gauze, instead o directly from the gas jet. It was described in NATURE, vol. v. p. 30, and some further experiments on this kind of flame are to be found in the journal of the Franklin Institute for April 1872.

Perhaps it is not out of place to add here that when a sensitive flame under the influence of sound is viewed in a moving mirror, the state of its vibration, thus seen, reveals some interesting facts. Under such circumstances, the flame is capable of showing the nature of the different vowel sounds, and further, by the broken appearance of the flame one is able to detect sonorous vibrations too faint to be heard and too feeble otherwise to affect the flame. I have given a representation of the flame seen in a moving mirror on the plate appended to an article in the *Popular Science Review* for April 1867. The flame that is most suited for the vowel experiments happens to be the parent of the family of sensitive flames, and is described in a little paper of mine in the *Philosophical Magazine* for March 1867.

W. F. BARRETT

Science Schools, South Kensington, July 27

Aid to Private Research—Circulation of Scientific Memoirs

THERE are many scientific students scattered through the country, as science-masters in schools, and in other capacities, who are willing and competent to undertake original researches in their special branches of science. The great obstacle to their attempting it is, in most cases, the cost of the necessary instruments. It is of course impossible to expect such apparatus as is required for original work to be supplied from the science funds of a school, these being properly applied to provide only what is requisite for teaching the pupils; so that if an investigation is to be attempted, the whole cost falls upon one who is probably just beginning life, and is quite unable to afford it. The work is therefore postponed for a considerable period, and perhaps is given up altogether. Now the Department of Science and Art grants aid in fitting up the schools which are under its control. If the Department would give similar aid towards purchasing expensive apparatus for research, or would allow competent workers to hire such instruments for the period they require them, much of the difficulty to which I have alluded would be removed. Many, I am sure, would be glad to avail themselves of the opportunity, and would willingly fulfil the conditions necessary to ensure the safety and proper use of the apparatus. I may remark that by this means it would probably be easy to organise to a certain extent the investigations to be carried on, and thus render the results far more valuable than they would be if isolated. Looking to the national importance and the unremunerative character of this kind of work, few will think that this appeal is exorbitant.

I wish to allude to another point, to which attention has already been drawn in your correspondence columns (NATURE, vol. viii. pp. 506, 550). A scientific man, unless he is fortunate enough to be within easy distance of a large scientific library, is practically debarred from reading even the most valuable memoirs that are published. Abstracts, indeed, he may see; but these only serve to remind him that if he would get the original memoir for himself, he must purchase with it matter which is useless to him, but perhaps of the highest value to a worker in another branch. If these memoirs could be purchased in a separate form—or even if collections of papers bearing upon closely related subjects could be obtained—another cause of the costliness of science would be removed.

It has occurred to me that something ought to be done amongst ourselves to remedy our position as regards the transactions of the learned societies and the scientific periodicals. Could not a book-club be instituted, the members of which, upon paying a small annual subscription, should receive in turn the chief scientific periodicals? Or would it be more easy for a number of us who happen to take in different journals, to exchange them? If any of your readers should be inclined to co-operate with me in initiating either of these schemes, or to furnish any suggestions on the subject, I should be glad if he would communicate with me.

Sherborne, Dorset, July 11 H. W. LLOYD TANNER

Photographic Irradiation

As the question of whether irradiation is due to the imperfection of the instruments, or to an action taking place within the thickness of the collodion film, is a matter of considerable importance in all cases in which photography is made use of for the purposes of accurate measurement, I have repeated and somewhat varied the experiments which have lately been described in NATURE, vol. x. pp. 205, 223, by Mr. Ranyard. I therefore laid on a uranium dry plate a piece of platinum foil, and with full aperture of lens took, with an exposure of twenty-five minutes, a photograph of a piece of cardboard, in which were four parallel slits, hung against a background of bright sky. In spite of the long exposure, the images of the slits are sharply cut off at the place occupied by the edge of the platinum foil, though at the same time there are very marked traces of the outer hazy irradiation arising from reflection from the back of the plate. I then took with the same exposure, and under what seemed to be similar conditions of illumination, a photograph of the same cardboard sheet, on an extra-sensitive Liverpool plate, and again found that the images of the slits were sharply cut off. This seems to me to decisively show that the irradiation cannot be due to a spreading within the film, caused by the light dispersed from the highly illuminated particles in the collodion, as suggested by Mr. Aitken; and I feel inclined to agree with Lord Lindsay and Mr. Ranyard that it must be due to some cause that has its seat of action in front of the collodion film.

Bedford W. C. CROFTS

Feathering in Flint Weapons

IT is now some years since I first noticed the fact that in a number of flint weapon heads in my possession a distinct spiral could be traced in the form, this being evidently due in part to the direction of the line of fracture in the flint, but also in part to an exaggeration of this by the hand of the workman. In the last number of the *Scientific American* is depicted an arrow-head with the edges very distinctly feathered, so that if the weapon with which it was armed was propelled with any great rapidity, its revolution would be a matter of necessity and would result in a greater steadiness in its line of trajectory.

After having ascertained that my own weapons were all twisted, I examined a number of others with the view of ascertaining if the same spiral existed in them, and in all I found that there was something like it, and the more finish they presented the more twisted they were.

A very simple method enabled me to show the twist well. I pressed a flint between two pieces of greased pipeclay, then removed it carefully and filled its place with liquid plaster of Paris. Cross-sections of this cast in various directions showed the twist to perfection, and I found that the two wings of the flint were twisted in opposite directions though identical in relation to the axis of rotation), and that the curvatures were identical with those seen in the iron arrow-heads provided with wings which are used in many savage countries to this day, and were till lately, if indeed they are not still, made in large quantities in Birmingham. The most perfectly twisted stone arrow-head which I have yet seen is one made of quartz, where the line of fracture could not help the manufacturer in the least, and where it must have been the result of deliberate workmanship. It was an American weapon. The line of fracture of flint always gives a more or less pronounced spiral, and this may be one of the many reasons for its having been almost universally selected as the material for arrow-heads when it could be got. In fact, it is a difficult thing to find a flint flake of any size which has not a very evident spiral form, and I have a photograph in my possession of two weapons which I have examined and which are almost identical, one found without its shaft near Bridlington, in Yorkshire, and one with its shaft found in the hands of a native of New Zealand; and it would be impossible to tell, from the style of manufacture, which weapon belonged to which country. It is impossible to regard this as mere coincidence, but we must look on it, in each case, as an independent discovery of the principle of the rotation of the rifled projectile. LAWSON TAIT

LOCALISATION OF FUNCTIONS IN THE BRAIN

AT one of the last meetings of the Royal Society, Dr. Burdon-Sanderson related the results of experiments he had recently made with a view to the further investigation of the important discovery of Hitzig and Fritsch, that there are certain spots on the surface of the cerebral hemispheres by the excitation of which the muscles of the opposite side of the body can be thrown into combined action.

It is well known that Dr. Ferrier, of King's College, who has studied the topographical distribution and limitation of these active spots or areas with great minuteness on a considerable variety of animals, has founded upon his experiments a theory that these spots correspond to organs situated at or near the surface of the hemispheres, and that it is the function of these organs to originate combined voluntary movements. Dr. Ferrier has accordingly proposed to call them "motor centres."

As, however, the facts appeared to Dr. Sanderson to be quite as consistent with the view previously entertained by physiologists that the function of co-ordinating voluntary movements is localised lower down in the cerebro-spinal centres, he thought it necessary to ascertain, with reference to some of the most characteristic combined movements produced by stimulation of the surface of the brain, by the interrupted voltaic current (Hitzig and Fritsch), or by induced currents (Ferrier), whether the very same combinations of movements could not be produced after ablation of the grey substance in which the "centres" for their production were supposed to be contained. If it could be shown that after complete removal of the "centres," the effects to the production of which they were supposed to be essential could still be observed, this would go far to prove that the facts had been misinterpreted; and if it could be further shown, not only that the phenomena might present themselves in animals deprived of the centres from which they were supposed to originate, but that they could be produced in such animals by the same methods and under the same circumstances as in normal animals, this would go far to negative the existence of any organs at the surface of the brain to which the term "motor centre" could with any propriety or accuracy be applied.

In accordance with these considerations, Dr. Sanderson planned experiments, in some of which the superficial convolutions containing "centres" were removed, while in others the whole of the anterior part of the left hemisphere as far down as the outer portion of the *corpus striatum* was taken away with the aid of a sharpened spoon. In each case it was found (1) that when after the removal of the cortical grey substance, the cut surface of white substance is excited by induced currents, movements of the opposite side of the body are produced, which are of the same character as those which result from excitation of the natural surface; (2) that the excitability is limited to certain spots, which can be as sharply defined as those demonstrable on the natural surface; and (3) that the relative positions of the active spots on the cut and natural surfaces respectively correspond closely with each other.

Simultaneously with the publication of Dr. Sanderson's communication, a paper appeared in Eckhardt's *Beiträge*, in which an account was given of very similar experiments, of which the results, though incomplete, corresponded, so far as theory went, with those above related. We learn also that Prof. Hermann of Zürich has also made experiments which have led him to reject in the most unequivocal manner the conclusions of Hitzig and Fritsch.

THE FORM OF COMETS[*]

II.

LET us see what ideas, what explanations have been suggested by the aspect of these monstrous phenomena, so evidently subject to the influence of the sun.

On examining comets, the first idea which is presented to the mind is that the head of a comet is the seat of an emission of matter which takes place in a direction opposite to the sun; it seems as if the comet fused at one end, and that the matter thus thrown off is arranged into an immense plume, exactly like the smoke which escapes from the chimney of a steamer at full speed. Let us examine this analogy more closely, and suppose, first, the boat to be motionless, with the smoke ascending vertically in a perfectly calm atmosphere. Each puff of this smoke is sent into the air with a certain speed, and the successive sections of the vertical plume thus formed will represent the positions which these puffs will have reached at the same instant. The puffs first emitted will be the highest; the latest ones will be lowest; if then we knew the law of the ascending movement of any puff, we should thus be able to assign the instant at which each section of the vertical plume was shot forth. Meantime, should we set the steamer moving in the motionless air, the place at which each section is emitted will gradually advance; each of these will ascend almost vertically over its place, for the speed of the horizontal movement which the boat communicates to it will be very rapidly exhausted in resisting the motionless air, and at the end of a certain time these puffs will be found dispersed in an inclined plume, presenting a curvature more or less marked. At first, this curvature will assume a vertical direction, *i.e.* the direction of emission.

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[*] Continued from p. 229.

On the other hand, the successive puffs, in ascending, tend to spread out; the earliest and highest must then become rarefied and disappear from sight. The tail,—no, I should say the plume of smoke thus formed, must become less and less dense, at the same time becoming less and less distinct and gradually getting obliterated.

Does it not seem as if here we had put our finger upon a complete analogy? The comet proceeds on its way like a steamer; it describes round the sun an orbit elongated like the path of a bomb; heated more and more by the solar rays, its matter is expanded and escapes into space, like that of a rocket. Is it not natural that it should send off a plume analogous to that which escapes from the funnel of a machine in motion? If we knew the rate of emission of each puff of cometary vapour, would we not be able to calculate the place which it must occupy in the tail, and even the form of the tail itself? Reciprocally, after having carefully determined the figure of this tail, would we not be able to form some estimate of the rate of the nucleal emission of the comet? Such, very nearly, was Newton's point of view in studying these magnificent phenomena. The comet of 1680, which appeared in the time of Newton, had a tail of 25,000,000 leagues in length; it forcibly impressed this great geometer, and originated in his mind views similar to the analogy which we have just indicated.

But analogy is not always a perfectly trustworthy guide. Here the differences preponderate considerably over the likenesses. We have certainly in the heavens a heated body which in its progress emits vapours like a gigantic steamer; but where is the funnel, where is the atmosphere? And, remember, the atmosphere here plays an important part, for it is its presence which determines the ascent of the puffs of smoke. If these ascend, it is from the same cause as balloons, because they are lighter than air. Take away the air, instead of mounting they will fall. Well, in the sky there is no air; space is void of matter forming a continuous and ponderous medium, layer on layer, until the surface of the sun is reached. Moreover, Laplace has shown that the power of the sun in attracting a ponderable fluid will not extend beyond a very narrow limit. As to the ether of the physicist, it need not engage our attention for an instant, since, by definition, this hypothetical ether is imponderable. We shall not be much astonished that the genius of Newton should have been content with a similar analogy, if we only reflect on all the difficulties which the doctrine of attraction raised in the minds of the eighteenth century, and on the Cartesian prejudices which greeted its first appearance on the Continent. What would have happened if, at the first, the too absolute terms of this doctrine had seemed to be contradicted by the phenomena of the figure of comets? It was then necessary, at any cost, after having incontestably connected the movement of these bodies with the new doctrine, to let it also be seen, even though it was by an analogy somewhat forced, that their figure could be explained in the same manner.

Now that the doctrine of attraction is established on an immovable foundation, our mind is able to detach itself from the purely metaphysical part of the original affirmations, which presented it to us as the single force to which all celestial phenomena ought to be subordinated. But before invoking another force, it is necessary at the very outset to draw from attraction all the consequences applicable to comets; and we shall do so by showing that the force, which seems constantly to tend to unite, to agglomerate scattered material, is, in reality, also quite capable of producing in certain cases the opposite effect, viz., of undoing existing agglomerations.

To proceed in order, let us ask, first, why comets have tails while planets have not. Is it because comets approach closer to the sun and are thus subjected to a very powerful heat? Certainly not; for the planets Venus and Mercury, especially, are constantly closer to the sun than most of the comets at their perihelion, and yet neither Venus nor Mercury has the faintest trace of a tail. Must we attribute the figure of comets to the parabolic nature of their orbits, in virtue of which their distance from the sun varies enormously, while the planets remain always very nearly at the same distance from the centre of our solar system? An illustrious poet, Lamartine, wishing to depict a creator of the earth, indifferent to his creature, has beautifully said—

> Et d'un pied dédaigneux la lançant dans l'espace,
> Rentra dans son repos.

If the kick had been stronger, the earth would have been sent to describe a cometary orbit round the sun, *i.e.* an elongated ellipse or a parabola, instead of the circle which it now describes; but, for all that, it would not have become a comet, it would have had no tail. Do you know what shape would be the result on this supposition? The imperceptible solar tides of the ocean would be gradually restrained in proportion as the earth increased its distance from the sun, and soon would disappear altogether; our atmosphere would be more and more condensed into layers always spherical and concentric with the earth; our planet would be lost in the depths of infinite space without any other change than a more marked contraction due to the predominating cold of space.

Are comets, then, formed of matter different from that of the planets? No; such an idea cannot be accepted now that spectrum analysis has told us of the existence of sodium, magnesium, and calcium in the sun, hydrogen in the stars, and our ordinary gases even in the most distant nebulæ. Above all, we find the same elements subject to the same mechanical, physical, and chemical laws.

The truth is more simple. If our planets have no tails, it is because they have an enormous mass; if comets have tails, it is because their mass is extremely small, and because the attraction which this mass exercises upon their materials is not sufficient to hold them back and to overcome the external forces which tend to decompose them.

Now have we hit upon a notion which I must dwell upon all the more that it has not hitherto been sufficiently popularised. You have heard of a general law in the world of organised and living beings, called "the struggle for life," the fight or effort which it is necessary to make in order to live, *i.e.* to resist the external forces which tend to death. Those that have in themselves a sufficient resisting force are developed and found persistent races; the feeble succumb and disappear. The same law reigns in the heavens. A body would subsist eternally by virtue of its internal forces if it were alone; but every neighbouring body becomes for it a dissolving cause by virtue of the attraction which the former exercises on the latter. The strong resist; they are the planets: the weak yield and end by succumbing; they are the comets.

Mechanics will convince us of this. Let us take a comet far away from the sun, leaving out of consideration at first the very weak attraction to which the former is subject; we can do this, for it is then sensibly the same for all its parts. Its solid, liquid, or gaseous materials are under the influence of their mutual attractions and of the feeble heat which they receive from without, freely disposed in regular layers, superposed so as to form a globe spherical like the earth, a globe whose centre will be occupied by the most compact parts and whose surface will be formed of the lightest parts. Whether this globe be at rest or in motion, if things remain thus, the comet will subsist; you will see its bright nucleus surrounded by a less luminous but quite sunny nebulosity, and this same form will indicate to you a body in which the forces which act on all its parts are directed towards the centre. Such is the first form in which we have represented Donati's comet (Fig. 3).

But if the comet comes nearer to the sun, the solar attraction will rapidly modify this state of things. The parts nearest to the sun will be attracted more strongly than the centre, and will have a tendency to separate from it; the difference of the solar attraction on the various parts of the comet will have the effect of elongating that body somewhat in the direction of the radius vector; this is a phenomenon quite like that of the tides. The second sketch (Fig. 4) of the comet of 1858 offers an example of this; but already the eccentricity of the nucleus ought to put us on our guard against any incompleteness in our present reasoning, founded upon the sole consideration of attraction. Nevertheless, you see, the body remains entire; the solar action being very feeble, at that great distance, the attraction of the comet on its exterior strata still preponderates, and the resultant of these various forces at each point is still turned towards the interior; the layers which compose it are everywhere convex externally, and do not show any symptoms of dissolution.

But bring the comet still nearer to the sun; the attraction of that body will no longer be limited to the production of an elongation; you will see the external layers become still more deformed and finally open out so as to let matter escape.

There exists, for every body placed within the sphere of action of our sun, a surface limit beyond which its matter may not pass, under pain of escaping to that body and falling within the domain of the solar action. This surface limit depends on two things—the mass of the body and its distance from the sun. For a planet like the earth, whose mass is so considerable, this surface limit is very distant, and yet, within the still terrestrial region of its satellite, the moon, a child could lift, without much difficulty, a body which would weigh for us 36,000 kilogrammes, so feeble does the attraction of our globe become at that distance of 60 terrestrial radii. A little beyond the lunar orbit, a body would cease to belong to the earth, and would enter the exclusive domain of the sun. But for a comet, this surface limit is much nearer the nucleus, and, moreover, it draws nearer and nearer, in proportion as the comet approaches the sun. One of the most eminent professors of the high education, M. E. Roche, of Montpellier, has submitted this question to analysis, leaving aside accessory circumstances such as the rotatory movement of the body under consideration and the curvature of its trajectory; he has thus been enabled to discover that the surface which so limits a body in the vicinity of the sun presents two singular points in the direction of the radius vector, setting out from which this surface is widened out into conical network, in such a manner that the dissolution of a body the matter of which reaches or passes beyond these boundaries, is effected principally in the vicinity of the points referred to, flying, so to speak, into two pieces, thus obeying at once the attraction of the comet and especially the thenceforth preponderating attraction of the sun.

And it ought not to be objected to this that there is no reason why the matter of a body should tend thus to be separated from its centre and to fill a volume greater and greater, so as to reach or surpass the fatal limit. This tendency exists; it proceeds from the increasing heat which a body that approaches nearer and nearer to the sun experiences, and from the progressive expansion which thence follows in the matter. Certainly if the earth were drawn nearer to the sun, the dilatation of its solid nucleus would be a small matter, but thenceforth the seas would be reduced to vapour and would pass wholly into the atmosphere. In the case of comets, in which the matter presents a much less marked degree of aggregation—doubtless because its original heat, due to the union of the particles which compose it, was not sufficient to bring about all the chemical reactions—the solar heat produces an expansion comparable to that of gases. According to my calculations, this expansion dilates the radius of the concentric zones which we can distinguish so well in the head of Donati's comet, at the rate of 19 metres per second. So long as these zones remain in the interior of the surface-limit, they are not dissolved; but if they should happen to go beyond it, their materials go off at the bidding of the sun's attraction.

Thus all the conditions of instability are found united in comets. Their mass is extremely small, and, consequently, the surface limit is very near the centre of gravity. Their distance from the sun diminishes rapidly in the descending branch of their trajectory; consequently this surface limit becomes more and more contracted. Finally, their enormous volume tends unceasingly to dilate, because of the increasing heat of the sun, and to cause the cometary matter to shoot out beyond this surface limit.

What becomes of this matter after it is set free by the action of the sun? Having escaped from that of the comet, it will none the less preserve the original speed, *i.e.* the speed which the comet itself had at the moment of separation; this speed will scarcely be altered by the feeble attraction of the cometary nucleus, or by the internal movements of which I have spoken, since these are measured by a few metres per second, while the general motion round the sun takes place at the rate of 10, 15, 20 leagues and more per second. The molecules, separated and thenceforward independent, then describe isolated orbits around the sun, differing very little from that of the comet. Those which are found in advance go a little faster and take the lead; those which are behind remain a little in the rear; so that the abandoned materials are divided along the trajectory of the comet in front and in rear of the nucleus. In time these materials are separated considerably from the body from which they emanate, and are more and more disseminated; but considered at the moment of emission, they will form two visible appendages, two sorts of tails opposed and stratified on the orbit of the comet.

We touch here on the decisive point of our research. To take the final step it will be sufficient for us to consider the two figures 6 and 7. The first represents the successive shapes C, C′, C″, which a comet must take, according to the preceding theory, if there were no other force in play than that of attraction. Fig. 7 represents the actual fact, *i.e.* the forms which a comet assumes in reality according to its progress in its orbit round the sun, S. Evidently there is no resemblance between these two series of figures. Then the preceding theory fails in some point, and as the error will not have been in the part attributed to attraction, it must be found in the assumption that this is the only force. In other words, it is sufficient to compare the effects of attraction with the real facts, to be convinced that there must be another force at work in the cometary phenomena. And as the former would be capable only of disseminating the matter along the orbit, the new force must be capable of driving this same matter in the direction of the radius vector; it must then be opposed to attraction; it must repel and not draw. What may this force be? Ought it not to make itself felt elsewhere than in the gigantic tails of comets? How can the same body, the sun, at once attract and repel matters of the same origin? And how does it come to pass that since it acts so powerfully on the matter of these bodies, this repelling force of the sun does not change the movement of their nuclei which appear to follow so faithfully the laws of solar attraction? This last question will put us on the right track.

And first, do comets follow rigorously, like planets, the laws of attraction? That the law has been firmly established in the case of the planets, I cannot doubt, for we have for these bodies a historic series of observations going back to the Chaldeans and including thousands of revolutions of each of them. If there had been the least disagreement between the phenomena and the law to which they are assigned, the disagreement, no matter how small, must at length have become sensible, after accumulating during so lengthened a period. But comets, in general, appear only once; we only see them and can only observe them in a very restricted part of their orbit; so that should a very slight influence alter their movements, its effect would be confounded with the inevitable errors of observation, and astronomers would not be able to distinguish it. There are, no doubt, some periodic comets, such as those of Halley, Biéla, Encke, &c., but the first has a period of seventy-five years, so that in going back to its earlier appearances, we very soon reach the time when comets belonged to the domain of astrology. That of Biéla has a period of 6⅔ years, but its first certain appearance dates only from the end of last century, and in the course of that time a singular accident has happened to it: it has been divided in two. There remains Encke's comet, the only one which can be subjected to the verification of which we have spoken, on account of the numerous revolutions which it has accomplished since its discovery in 1786. Well, it is found that this comet, the only one which can be tested in the way we speak of, does not follow exactly the laws of gravitation. According to these laws, when we have taken account of the perturbations caused by the neighbouring planets, the time of revolution ought to be constant, while, in fact, it diminishes regularly during each revolution; the effect established in this instance is of considerable magnitude, about half a day.

FIG. 9.

In face of such a fact there is room for the question under consideration, viz., Is attraction the only force which governs the universe? But how can we formulate such a doubt, when the carefully-studied movements of the planets may be perfectly accounted for, for thousands of years past, exclusively by the theory of attraction? We can escape the difficulty by an artifice identical with that which enabled Newton to account for the tails of comets by attraction alone: I refer to that vast and rare atmosphere which Newton placed in space around the sun, and in the midst of which the cometary materials are elevated, according to him, exactly as the smoke of our chimneys in our terrestrial atmosphere. Geometers, then, introduced the resistance which this general medium ought to oppose to the progress of a comet on account of its small density, while the same medium would oppose only an insensible resistance to the planets on account of their relatively small volume and their enormous density. It is a remarkable fact that the analysis founded on this impossible hypothesis perfectly accounts for the anomaly proved to exist in the orbit of Encke's comet, viz., its progressive acceleration. I feel bound to question this analysis, and to show (1) that its primary basis is radically false, since it leads to the admission that a material and ponderable medium may remain immovable around the sun; (2) that the conclusion of this analysis, so far as it is valid and conformable to observation, simply proves that there must exist an action opposed to the movement of the comet and directed along the tangent to its orbit. Various causes, moreover, may lead to the same conclusion, and differ only, as to other effects, in quantities difficult to appreciate. But we learned above, from the phenomena of the tails, that there also exists an action in the direction of the radius vector. The resisting medium of Encke, or the immense solar atmosphere of Newton, being physically impossible, I have been led, by two different ways, to a new force which would satisfy these data by producing the two actions or components above mentioned: that which expels the cometary molecules in the direction of the radius vector, and that which acts upon the comet in the inverse ratio of its tangential velocity.

FIG. 7.

(*To be continued.*)

REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL"*

VI.

IN no animal has the study of cranial development yielded richer results than in the frog. In tadpoles, from the time of hatching onwards, such points as the true nature of the trabeculæ, and their distinctness from the investing mass, the fact that the stapes is a segmented portion of the ear-capsule, and not the apex of the hyoid arch, and the relations of the pterygo-palatine arcade have been demonstrated with certainty. Most instructive, also, is the way in which the various arches become segmented, altered in shape, direction, and relative size, and made to subserve the most various functions.

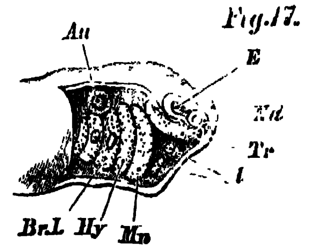

FIG. 17.—Head of Tadpole 2—3 lines long, with the facial arches exposed by removal of the skin from the left side (× 6½).

Besides the adult, nine stages of the frog's skull were described.

1. (Fig. 17).—In tadpoles at about the time of hatching the whole organism is in a very rudimentary condition. The mouth and the gill-slits are closed, the dehiscence of the tissue between the facial arches by which they are formed not having yet taken place. On the first and second branchial arches small papillæ, the rudiments of the external gills, have made their appearance (see Fig. 17). The little creature, now about a quarter of an inch or less in length, is usually found attached to water weeds by the horseshoe-shaped sucker beneath its throat, which, though serving the same purpose, must on no account be confounded with the suctorial mouth of the lamprey. The facial arches are in a perfectly simple and undivided condition, all those behind the mouth are curved slightly backwards in the lower half, while the trabeculæ incline forwards and are thus made to diverge considerably from the mandibulars, although in their upper portion they have almost exactly the same inclination as their successors in the series. The investing mass consists of two small patches of nascent cartilage, one on each side of the notochord. The auditory are the only sense-capsules which have undergone chondrification, and in them the process is quite incomplete, a large membranous space being still left uncovered by cartilage. Two pairs of labial cartilages (l) are formed, and probably answer in a general way to the first and fifth of the series described in the shark (see Fig. 2, l^1, l^5).

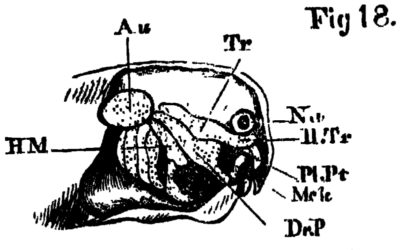

FIG. 18.—Head of Tadpole, 5 lines long (× 6½). Or.P. Orbitar process.

2. Tadpole about ⅓ in. long). The external gills have now (four or five days after hatching) become plumose and the mouth and branchial clefts open freely into the pharyngeal cavity. The most important advance is in the commencing separation of a small segment (hypo-mandibular) from the second arch, which in the next stage has become Meckel's cartilage. The hyoid has also begun to diverge from its predecessor in its lower part, and a fourth branchial arch has appeared in addition to the three observable in the first stage.

3. (Tadpole about ½ in. in length, Fig. 18.) The trabeculæ have now united with the investing mass and with each other before and behind the pituitary body, and have become almost horizontal; they likewise begin to foreshadow some of the changes which afterwards take place in them, becoming slender anteriorly, to form the cornua trabeculæ (H.Tr), and just behind the olfactory sac being thickened slightly in the future ethmoidal region. Meckel's cartilage now forms a true articulation with the fixed or suspensorial portion of the arch to which it belongs; slightly above the articulation two processes are sent out from the suspensorium; the outer (Or.P) is the *orbitar process*, while the inner (Pl.Pt), uniting with the trabecula, forms a commissural band of cartilage, the rudiment of the pterygo-palatine arcade: between these two processes, the second and third divisions of the trigeminal nerve run. The hyoid arch has assumed a wonderfully shark-like character (see Fig. 2), having divided into an upper and a lower segment, the former of which (hyo-mandibular, H.M) has come into close relation with the preceding arch, while the latter hangs free, forming an open angle with the mandible, and unites with its fellow of the opposite side by means of a median basihyal. The investing mass and ear-capsules are now completely cartilaginous.

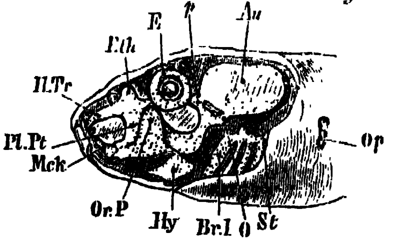

FIG. 19. -Head of Tadpole, 1 in. long (× 4½). Op. Opercular aperture.

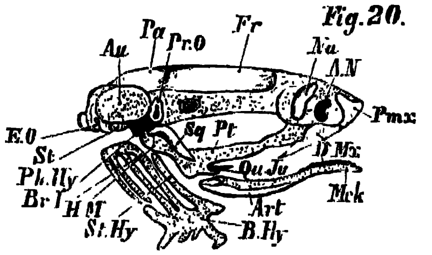

FIG. 20.—Skull of Young Frog, with tail just absorbed (×) 5).

4. (Tadpoles 1 in. long, Fig. 19.) At this stage the hind limbs have made their appearance, and the opercular fold has completely grown over the gill arches on the right side, a small slit (Op) still remaining on the left. The cranial elements have now assumed somewhat the appearance of a skull, which however differs most markedly from that of the adult frog. The trabeculæ, by complete union in their hinder two-thirds with each other and with the investing mass, have formed a solid *basis cranii;* they have also sent up a low wall on either side of the brain, thus tending to inclose it, and just in front of their union with the pterygo-palatine have developed a prominent transverse ridge (Fig. 19, Eth), the rudiment of

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* Continued from p. 168.

the ethmoid. The suspensorium is still greatly inclined forwards, so that the quadrate lies immediately under the ethmoidal region, and, consequently, the palato-pterygoid and Meckel's cartilage, though lengthening, are still extremely short. The hyo-mandibular has completely coalesced with the suspensorium, which is now therefore a compound structure, and presents above two of the three processes mentioned in the axolotl, namely the pedicle (p) and the otic process (o), the latter at this period belonging equally to both arches, the pedicle to the mandibular only. The branchial arches have united with one another above and below to form a perfect branchial basket. The stapes (St) is now completely cut out of the wall of the ear sac, and the first ossification has made its appearance on the base of the skull, in the position of the para-sphenoid.

5. In tadpoles in which the legs have increased greatly in size and the tail has begun to shrink, a marked advance has taken place in the proportion of the jaws to the rest of the skull; the mandibular pier has moved downwards and backwards so as to lie at an angle of 45° with the skull-flow, and the palato-pterygoid and lower jaw are correspondingly lengthened. (Fig. 20 shows the process further advanced.) The orbitar process is greatly decreased in size and lies higher up on the suspensorium, and the ethmoidal cartilage has sent out a vertical keel-like plate (the septum nasi) between the olfactory sacs.

6. The tadpole has now moulted its larval skin, so as to expose the fore-limbs, and the tail is reduced to half its original size. The walls of the brain-case, commenced in the fourth stage, are now complete, and by their union above have formed a roof, interrupted only by their membranous fontanelles, which are persistent in the adult, one in the frontal, and a symmetrical pair of smaller ones in the parietal region. The septum nasi is complete, and two wing-like processes growing from it have inclosed the nasal capsules by uniting with the floor formed by the greatly expanded hypo-trabeculars. The hyoidean portion of the otic process (Fig. 19, o) has now freed itself from its connections, and appears as a triangular nodule of cartilage, the pharyngo-hyal (Fig. 20, Ph.Hy), or detached apex of the arch; at the same time the remainder of the coalesced portion (Figs 18 and 20, H.M) begins to show signs of separating once more from its union with the mandibular pier. Besides the para-sphenoid, the parietal, frontal, nasal, pre-maxillary, maxillary, squamosal, articular, and dentary ossifications have appeared.

7 (Fig. 20). The skull of young frogs in which the tail has just disappeared differs from that described in the last stage, chiefly by the extension of the centres of ossification already mentioned, and the appearance in addition of the exoccipital, prootic, pterygoid, quadrato-jugal, and septo-maxillary. The free portion of the hyoid (St. Hy) has assumed the slender proportions which characterise it in the adult, and it is united by fibre to the upper part of the arch (H.M), which, although still fused with the suspensorium, is marked off from the latter by a distinct depression, and shows unequivocal signs of commencing separation.

8. A most important metamorphosis has taken place in this stage, which includes young frogs just commencing their first summer. The pharyngo-hyal or nodule of cartilage separated from its arch in the sixth stage (see Fig. 20, Ph.Hy) has now come into close contact with the stapes, although it does not actually articulate with it until the succeeding stage; this freed apex of the hyoid arch thus becomes the inter-stapedial piece (Fig. 16, p. 168, i.st) of the ossicula auditus, the representation of the *os orbiculare* of mammals. At the same time the next segment of the same arch (Fig. 20, H.M) has become completely separated from its connection with the suspensorium, and has taken on the form of the other three elements of the chain of ear-bones, the medio-, supra-, and extra-stapedials (Fig. 16, m.st, s.st, e.st), which together are the homologue of the mammalian *incus*. The malleus, although having its functional analogue in the extra-stapedial (the end of the chain fitting into the drum-membrane) is represented morphologically by the frog's suspensorial cartilage, being, as will be shown in a future paper, the proximal end of the mandibular arch.

9. The embryonic characters are now (first autumn) fast disappearing. The suspensorium is at right angles with the long axis of the skull, or almost exact half-way between the positions it occupies in the seventh stage (Fig. 20), and in the adult (Fig. 14, p. 168). The ossicula auditus have come into union with the stapes, and the stylo-hyal instead of being attached (as in Fig. 20) to the suspensorium, has grown backwards to its adult position, where, however, it is united only by fibrous tissue. The parietals and frontals are still separate, and the maxilla has not extended backwards to the quadrato-jugal, although the fibrous space between them is now quite small. The girdle-bone (Fig. 19, G) is singularly behindhand in its ossification; even at this stage it is represented only by a slender plate of bone immediately anterior to the frontals. At a further stage endosteal ossification sets up in the cartilage on either side of this region, so that the girdle-bone is formed by the coalescence of three separate centres.*

THE STRICKLAND CURATORSHIP IN THE UNIVERSITY OF CAMBRIDGE

THE Vice-Chancellor of the University of Cambridge has approved the nomination, by Miss Frances Strickland, of Apperley Court, of Mr. Osbert Salvin, F.R.S., to the office of "Strickland Curator," lately founded and endowed by that lady, and the Museum of that University will therefore reap the benefit of having attached to it one of the best English ornithologists of the day. Mr. Salvin, being then a scholar of Trinity Hall, graduated in mathematical honours in 1857, and immediately afterwards proceeded to join Mr. (now Canon) Tristram in the natural history researches he was making in Algeria, the important results of which are known to many of our readers. In the following autumn he sailed for Central America, and there began that series of scientific observations which has made him the chief authority on the zoology of that part of the world. How many times he has since visited it we cannot say, but he only returned from his last expedition some two months ago, and he has besides been all the while well occupied. In addition to the many papers he has published, mostly on the birds of the Neotropical Region, he has, in conjunction with Mr. Sclater, brought out an illustrated "Exotic Ornithology," intended as a sequel to the celebrated works of Daubenton and Temminck, and in 1870 was chosen editor of the *Ibis*, the leading ornithological periodical of the world.

But our object here is not to sound the praises of Mr. Salvin, who, it will be seen from what we have said, does not requre them, but to point out the advantages that would accrue to science if posts for the study and promotion of its various other branches, similar to the recent foundation, were established in our Universities. We are greatly mistaken if the "Strickland Curatorship" is not the very first step that has been made towards a fulfilment of that idea of the endowment of research which has been often urged in these columns, and was especially recommended in the late Report of the Royal Commissioners on Scientific Instruction and Aid to Science. Admitting that the intention of Miss Strickland was mainly to secure the proper keeping of her late brother's ornithological collection, which was some years ago given by his widow to the University, what will be the effect of the foundation? The merely mechanical part of the curator's duties is slight. A collection once put in order is easily so retained. Even the cataloguing of it is a task that may not be expected to occupy an ornithologist of Mr. Salvin's ability, knowledge, and experience, a very long time—though catalogues in these days, to be worth anything, are more serious affairs than most people would fancy. The regulations of the office prescribe that its incumbent should then turn his attention to the other ornithological collections possessed by the University; and, even if the rest be trifling, the Swainson Collection may be expected to form a formidable undertaking—to say nothing of others that may be acquired from time to time. We take it for granted that the University will not allow such catalogues to remain in manuscript, but will print and publish them as they are completed. If so, it will be promoting the advancement of science in this particular direction in the most efficacious mode possible, and yet, be it remembered, not in a way that by any means can be termed "educational." The compilation of these catalogues will be purely a matter of research, and the amount of aid they will furnish to scientific ornithologists cannot be calculated. There can be little doubt that to the centre in which such good work is being done, many other collections will gravitate, and thus Cambridge will be for many years to come a recipient and disseminating focus of Ornithology.

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* It should have been stated in the last paper that Fig. 13 is taken from a drawing kindly furnished by Prof. Huxley.

Now, even the most ardent ornithologist will hardly maintain that his favourite study is the most important in the wide round of the sciences, or even of those which have to do with biology. The moral of the "Strickland Curatorship" is, that similar appointments ought to be established to do for other sciences what that will do for Ornithology. And even now we have to mention a curious fact which should be an encouragement for future founders or foundresses to cast their bread upon the waters: two other benefits to this branch of science have unexpectedly been the result of Miss Strickland's endowment. The naturalist first selected by her for the new appointment was the learned Dr. Finsch, who, until the last few months, had been pursuing his unwearied labours on a scanty and uncertain pittance at Bremen. When the good people of that city learned that they were likely to lose his services, they bethought them that it was expedient to retain him, and to do this they resolved upon raising his stipend and making his office in their museum permanent. In like manner it happened that Miss Strickland's next selection, a young naturalist of great promise, was induced to stay at Berlin by the creation of a post in the museum there specially for him. Thus the benefactress of Cambridge has the satisfaction of knowing that her bounty has been the means of providing for two meritorious men, besides accomplishing the object she had directly in view. Will no one come forward to further the good work she has so well begun? Now that there is a rumour that one of our greatest living naturalists is likely to be tempted by a glittering bait to the other side of the Atlantic, it is in the power of many a one to preserve the glory of his services to England by founding a Professorship of Biological Research in the University of John Ray and Charles Darwin!

A NEW ORDER OF HYDROZOA

ON the southern shores of France, at a slight depth below the surface of the sea, there may be found attached to stones small patches of one of the horny sponges which will probably arrest the attention of the zoologist by what will appear to him as an unusually obvious and well-defined condition of their efferent orifices or oscula.

If one of these patches be transferred to a phial of sea-water, the observer will soon be astonished by seeing that from every one of the apparent oscula a beautiful plume of hydroid tentacles will have become developed, and he will naturally believe that the form has at last been found which will remove all doubt as to the zoological position of the sponges, and decide in favour of the hydroid affinities recently assigned to them.*

A more careful examination, however, will show that the orifices on the surface have been incorrectly regarded as oscula, and that the tentacles form no part of the sponge, but proceed from an entirely different organism which is imbedded in its substance.

It will be further seen that the organism with which the sponge is thus associated is contained in a congeries of chitinous tubes which permeate the sponge-tissue, and open on its surface in the manner of genuine oscula, and it will be still further apparent that this organism, while undoubtedly a hydrozoon, and even presenting quite the aspect of a hydroid trophosome, is no hydroid at all, and cannot indeed be referred to any of the hitherto recognised orders of the Hydrozoa, but must take its place in an entirely new and as yet undefined order of this class.

The chitinous tubes and their contents are united by a common tubular plexus which lies towards the base of the sponge, and they thus constitute a composite colony of zooids. The tubes, towards their free extremities, where they open on the surface of the sponge, become much increased in width, and here their contents become developed into a very remarkable body, which has the power of extending itself beyond the orifice of the tube, and of again withdrawing itself far into the interior exactly like the hydranth or polypite of a campanularian hydroid in its hydrotheca. When extended, it displays from around the margin of a wide terminal orifice its beautiful crown of tentacles; but when withdrawn into the interior of the cup-like receptacle, the tentacles are greatly contracted and thrown back into the cavity of its body. Its general appearance, indeed, is very like that of a campanularian hydranth, and a careful examination is needed in order to show that it possesses all the essential characters, not of a hydranth, but of a medusa. It has a circular canal surrounding the terminal orifice and supporting the tentacular crown, and it has four symmetrically-disposed longitudinal canals extending from the circular canal backwards in the walls of the body. No manubrium could be detected, though this was carefully sought for at the point where it might be expected to be found, namely, where the medusiform zooid passes into the common cœnosarc which occupies the narrower portion of the tube; neither was there any appearance of a velum, nor of lithocysts or ocelli; but these are comparatively unessential modifications.

The reproductive system is probably developed in the walls of the longitudinal canals, but in none of the specimens examined was this part of the organisation sufficiently mature to admit of a satisfactory demonstration.

For the little animal thus constructed I propose the name of *Stephanoscyphus mirabilis*. Whether it is to be regarded as parasitically connected with the sponge, or whether the two are only accidentally associated, it is at present impossible to say. At all events, in no instance did I find the Stephanoscyphus unaccompanied by the sponge.

Stephanoscyphus may then be regarded as a compound hydrozoon, whose zooids are included in cup-like receptacles resembling the hydrothecæ of the calyptoblastic hydroids; but these zooids, instead of being constructed like the hydranths of a hydroid, are formed on the plan of a medusa. It has plainly very decided affinities with the Hydroida, but is nevertheless removed from these by a distance at least as great as that which separates from them the Siphonophora. It thus becomes the type of a new hydrozoal order, for which I propose the name of THECOMEDUSÆ. GEO. J. ALLMAN

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* See Haeckel's "Kalkschwämme."

ANOTHER NEW COMET.

THE following letter from Mr. J. R. Hind, dated Mr. Bishop's Observatory, Twickenham, July 27, appeared in Tuesday's *Times*:—

"M. Stephan, Director of the Observatory at Marseilles, notified to us by telegram yesterday the discovery of a comet on the previous night by M. Borrelly, a colleague of M. Coggia (to whom is due the first detection of the bright comet which we have just lost), at that Observatory. The position at 2 A.M. on the 26th inst. appears to have been close to the star Theta, in the constellation Draco, in right ascension 238 deg. 4 min., and polar distance 30 deg. 28 min. The comet is pretty bright, and its motion towards the west. Clouds have prevented any observation at Twickenham during the past night.

"A communication from Berlin this morning mentions—contrary to what I should yet have expected from my own calculations relating to the orbit—that Dr. Tietjen, of the Imperial Observatory, has found indications of a sensible deviation from parabolic motion in the recent bright comet between April 19 and July 14. The curve is elliptical, but the inferred period of revolution is of such length as to be open at present to uncertainty, which can only be removed by observations in the other hemisphere. The semi-axis major is found to be rather more than 430 times the earth's mean distance from the sun, and the corresponding length of revolution is nearly 9,000 years.

"The tail of the late comet increased very quickly and considerably in length, as frequently happens soon after perihelion passage. Assuming it to have proceeded from the nucleus very nearly in the direction opposite to that of the sun, its actual length had increased from 4,000,000 miles on July 3 to 16,000,000 on the 13th, and on the 19th, the last night it was visible in this hemisphere, to something over 25,000,000 miles. The increase of apparent length in this interval was from 4 deg. to 43½ deg."

NOTES

THE Priestley Centenary is to be celebrated, not only at Birmingham, as we have before announced, but at Leeds, by two meetings, to be held in the hall of the Philosophical Society. The chair will be occupied at the two meetings by Dr. Clifford Allbutt and Mr. Sykes Ward, F.C.S., and addresses are to be given by the Rev. J. C. Odgers, who is to read a paper On the personal history of Priestley; Mr. T. Fairley, F.C.S., On the phlogiston theory; and Mr. S. Jefferson, F.C.S., On the discovery of oxygen.

DR. ACLAND, Regius Professor of Medicine in the University of Oxford, has been appointed president of the Medical Council, in succession to Dr. Paget, of Cambridge. We believe the appointment is a five-yearly one.

AT a general meeting of the Council of the Yorkshire College of Science, held last Friday, Dr. T. E. Thorpe was elected Professor of Chemistry. Dr. Thorpe has for the last four years had the direction of large classes in theoretical and practical chemistry at the Andersonian University, Glasgow. He is the author of "A Manual of Inorganic Chemistry" and "A Text Book of Quantitative Chemical Analysis," and has made many original contributions to chemical literature.

THE death is announced of Father Paul Rosa, the colleague of Father Secchi at the Roman Observatory.

THE Select Committee of the Legislative Assembly of New South Wales, which was appointed to inquire into the management of the Sydney Museum, has furnished its report, in which the appointment of a Curator, with complete charge of the property of the Museum, subject to the Minister of Public Instruction, is proposed; at the same time an extension of the building at present holding the collection is suggested.

MR. C. A. BOWDLER's apparatus for steering balloons was tested on Saturday last at Woolwich, in the presence of several officers of the scientific branches of the army. The balloon to which the apparatus was attached was the new large one, 80 ft. high, belonging to Mr. Coxwell, which was considered by Mr. Bowdler too large for the size of his machine. His apparatus is very simple, consisting of fans like the screw propeller of a ship, 3 ft. in diameter, and making 12 or 14 revolutions per second, worked by hand. When the balloon was exactly balanced the vertical fan caused it to rise and fall, but the horizontal fan was found to have no effect whatever in guiding the direction.

THE French National Assembly has adopted the proposal to award to M. Pasteur a pension of 12,000 francs, one half of which reverts to his wife should she survive him.

WE view with great pleasure the advance of the Birkbeck Institution within the last few years in its scientific department. Quite recently a scientific society has been established in connection therewith, the object of which is to inculcate and develop a taste for scientific pursuits among its members, by the reading of original papers upon scientific subjects and by debates, and particularly for the encouragement of the application of scientific principles to the arts and manufactures. In immediate connection with this society we find a Naturalists' Field Club, the aim of which is to organise excursions to the various districts possessing scientific interest, for the purpose of studying practically and under the direction of practical men, those sciences, such as geology, mineralogy, botany, &c., a real and sound knowledge of which can only be obtained by the actual study of Nature. We wish this new undertaking all possible success. As a proof of the high character of the work performed by this institution and the excellence of the instruction provided, we need only call attention to the fact that this year its students have been awarded one half of the total number of prizes offered for public competition by the Society of Arts at its annual examinations.

THE Royal Academy of Belgium proposes the following subjects for prizes to be awarded in 1875:—1. To examine and discuss, on the basis of new experiments, the perturbing causes which influence the determination of the electro-motive force and the interior resistance of an element of the electric pile; to find out the number of these two quantities for some of the principal piles. 2. To give an exposition of the knowledge attained on the relations of heat to the development of phanerogamous plants, particularly in reference to the periodic phenomena of vegetation; and, in this connection, to discuss the value of the dynamical influence of solar heat on the evolution of plants. 3. To make new researches on the embryonic development of the *Tunicata*. 4. To make new researches to establish the compositon and mutual relations of albumenoid substances. 5. To describe the coal-system of the basin of Liége. A gold medal of the value of 1,000 francs is the prize in subjects 4 and 5: one of 600 francs for subjects 1, 2, and 3. The memoirs ought to reach the Secretary of the Academy before August 1, 1875. They must be written either in Latin, French, or Flemish.

THE destruction of vineyards by *Phylloxera*, which has lately so much engaged the attention of entomologists and botanists, was recently the subject of a bill in the French Assembly. Many prefects, on the plea of public welfare, have issued orders for the uprooting and burning of diseased plants, and opposing the introduction of foreign stocks; but to make this desperate course effectual, a special law putting the *Phylloxera* on a level with the rinderpest is necessary. M. Destreaux has submitted a bill to make this possible, and the Academy of Sciences gives it its support. Notwithstanding the investigations that have made, no reliable specific against *Phylloxera* seems to have been yet discovered. The bill before the Assembly is received as "urgent."

MR. NEWBIGGING, in his "Handbook for Gas Engineers and Managers," London, 1870, p. 159, gives a "Chronology of Gas Lighting." By this author's statement the first public exhibition of gas in London was in 1807, by Mr. Winsor, who lighted Pall Mall at that time. But Prof. B. Silliman, writing to the *American Gas Light Journal*, gives an extract from the elder Prof. Silliman's "Journal of Travels in England, Holland, and Scotland," containing a description of a public exhibition of illuminating gas from coal in July 1805, by "an ingenious apothecary" in Piccadilly, near Albany House. "The inflammable gas," the journal states, "is extricated simply by heating common fossil coal in a furnace, with a proper apparatus to prevent the escape of the gas, and to conduct it into a large vessel of water, which condenses the bituminous matter resembling tar, and several other products of the distillation that are foreign to the principal object. The gas, being thus washed and purified, is allowed to ascend through a main tube, and is then distributed by means of other tubes concealed in the structure of the room, and branching off in every desired direction, till, at last, they communicate with sconces along the walls, and with chandeliers depending from the roof, in such a manner that the gas issues in streams from orifices situated where the candles are commonly placed. Then it is set on fire, and forms very beautiful jets of flame, of great brilliancy; and from their being numerous, long, and pointed, and waving with every breath of air, they have an effect almost magical, and seem as if endowed with a kind of animation. The gas is sometimes made to escape in revolving jets, when it forms circles of flame—and, in short, there is no end to the variety of forms which ingenuity and fancy may give to this brilliant invention. The expense of the apparatus, and its liability to accidents, forms an obstacle of magnitude, and, on the whole, it is probable it will not be generally adopted." This is curious reading in 1874! Mr. Murdock had employed gas illumination in 1792, and gas was used in Paris in 1802. But London was in the dark until 1805.

DR. MELLICHAMP, of Bluffton, South Carolina, has been prosecuting researches on the pitchers of *Sarracenia variolaris* and the way in which insects are caught in them. The species abounds in this district, and even early in May many pitchers were developed. He has confirmed the presence of the sugary secretion within the rim. He finds that it bedews the throat all the way round the rim, and extends downwards from ¼ in. to ¾ in. Dr. Mellichamp also finds—and this is his most curious discovery—that this sweet secretion is continued externally in a line along the edge of the wing of the pitchers down to the petiole or to the ground, forming a honeyed trail or pathway up which some insects, and especially ants, travel to the more copious feeding ground above, whence they are precipitated into the well beneath. Ants are largely accumulated in these pitchers. As to the supposed intoxicating qualities of this secretion, Dr. Mellichamp was unable to find any evidence of it. On cutting off the summit of the pitchers and exposing them freely to flies in his house, he found that the insects which came to them, and fed upon the sweet matter with avidity, flew away after sipping their fill, to all appearance unharmed. On the other hand, he thinks that the watery liquid in which the insects are drowned and macerated possesses anæsthetic properties; that house-flies, after brief immersion in it, and when permitted to walk about in a thin layer of it, "were invariably killed—as at first supposed—or at any rate stupefied or paralysed in from half a minute to three or five minutes," but most of them would revive very gradually in the course of an hour or so.

IT is probable that a scheme for the establishment of another Medical School at Dacca, on the same footing as those of Calcutta and Patna, will shortly be sanctioned by Government.

THE success which has attended the ostrich-breeding farms in South Africa has induced some French gentlemen to endeavour to imitate the system in Algeria, and African birds have also been sent to La Plata and other countries in South America, where it is hoped they may take the place of the native birds, which are inferior in quality to the African ostrich. Generally speaking, the system on which ostrich farms are conducted is as follows. The birds kept for breeding purposes, about three years old, are placed in separate paddocks, in pairs, and their eggs are either hatched in the natural way or placed in incubators prepared for the purpose. By this means a larger proportion of eggs is hatched. The young birds are fed on grass, lucerne, and other vegetable matters, and are sheltered at night. Each pair of birds will produce about twenty chickens, which may be plucked when they are about eighteen months old, before which time the feathers are not of much value. The price of good ostrich feathers, wholesale, is about 40*l*. per pound weight. If the birds are well kept, and have plenty of exercise and food, their feathers are of good quality; but the plumage of wild birds is considered superior to that of inferior tame ones. The value of each year's plucking from the young birds is about 7*l*., and of the birds themselves at six months old is 30*l*. to 35*l*. The breeding birds are worth 125*l*. per pair.

THE new screw steamship *Durham* sailed from Plymouth on Sunday, bound for Melbourne, having on board several members of the Imperial German Astronomical Expedition. They carry with them a large number of instruments with which to observe from Port Ross, one of the Auckland Islands, the coming transit of Venus.

WE have received, reprinted from the excellent Indian ornithological journal *Stray Feathers*, a copy of a lengthy paper by Mr. V. Ball, on the Avifauna of the Chota Nagpur division of Bengal, which, besides giving an account of the birds found in the district, contains an instructive description of its geology, flora, and mammalian fauna; the author laying great stress, as is but too seldom done, on the interdependence between these mutually related phenomena.

THE tenacity of life of popular errors is well exhibited in the following extract from the *Californian Horticulturist*:—"The influence of forests in drawing moisture from the heavens may be seen from the experience of San Diego, California. Previous to 1863 there was yearly a rainy season, which made the soil nourishing and productive. In 1863 a destructive fire swept over the greater part of the country, destroying the forest and blackening the hills. Since then there has been no rainy season at San Diego." When will public writers learn that forests influence the climate by drawing water, not from the air, but from the soil?

AN addition is in preparation to the Colonial Floras published under the authority of our Colonial Government, in the form of a "Flora of Mauritius." It will be edited by Mr. J. G. Baker, assistant-curator to the Kew Herbarium.

PROF. SCHIMPER, of Strassburg, in a paper read before the Botanical Congress at Florence, claims to have discovered a fossil plant in "protogine," a rock hitherto considered of igneous origin, which occurs in the form of erratic blocks on the sides of Mont Blanc and in the plains of Piedmont. The specimen, which was collected by M. Sismonda, and is preserved in the Museum of the Turin University, has been identified by Prof. Schimper as *Annularia sphenophylloides*, a plant, perhaps aquatic, widely distributed in the coal-strata of Mont Blanc.

A DRAWING-ROOM meeting in aid of the Palestine Exploration Fund was held on the 24th inst. at the residence of the Duke of Westminster, Grosvenor House. Capt. Warren, before giving an account of his experiences, made an appeal to the meeting for increased support to carry on the work of exploration, which was at present flagging for want of funds. He urged the subscribers to the Fund to complete the work of surveying the country as soon as possible, as the land, being so fertile, was constantly being taken by the Greeks and other foreign cultivators of the soil for farming purposes. As a consequence, the old names of the towns and villages were fast disappearing, and the whole country was assuming a different aspect. This meeting was the first of a series that is to be held, information as to which can be obtained of the secretary at the office of the Fund, 9, Pall Mall East.

ACCORDING to the State geologist of Minnesota, the cretaceous lignite beds of Minnesota Valley are likely to afford valuable coal mines.

IN the report to the Admiralty of Capt. G. S. Nares, of H.M.S. *Challenger*, dated Melbourne, March 25, 1874, Capt. Nares, speaking of the temperature of the ocean, especially near the pack edge of the ice, says:—"At a short distance from the pack, the surface water rose to 32°, but at a depth of 40 fathoms we always found the temperature to be 29°; this continued to 300 fathoms, the depth in which most of the icebergs float, after which there is a stratum of slightly warmer water of 33° or 34°. As the thermometers had to pass through these two belts of water before reaching the bottom, the indices registered those temperatures, and it was impossible to obtain the exact temperature of the bottom whilst near the ice, but the observations made in lower latitudes show that it is about 31°. More exact results could not have been obtained even had Mr. Siemens' apparatus been on board." It seems to us that the difficulty mentioned is one which would certainly have been surmounted by Messrs. Negretti and Zambra's new recording thermometers, a description of which appeared in NATURE, vol. ix. p. 387; this being exactly one of the cases to which this instrument is peculiarly adapted. We believe the inventors and makers have greatly improved their thermometer since our description appeared, and no doubt means will be taken by the Admiralty to transmit one to the *Challenger*.

MR. PILLISCHER, optician and scientific instrument maker, of New Bond Street, W., has been decorated by the Emperor of Austria with the golden Cross and Crown of Merit, as are cognition of his Majesty's approval of the superior quality and precision of his scientific instruments shown at the late Vienna Exhibition.

THE following is a list of candidates successful in the competition for the Whitworth Scholarships (Science and Art Department), 1874:—William Martin, metal turner, Wolverton; Robert A. Sloan, engineer's apprentice, Birkenhead; William Sisson, engineer, Gateshead; Frederick Stubbs, engineer's apprentice, Derby; Thomas L. Daltry, draughtsman's apprentice, Newcastle-on-Tyne; Frederick H. Livens, engineer's apprentice, Gainsborough.

THE additions to the Zoological Society's Gardens during the past week include two Tigers (*Felis tigris*) from Calcutta; two Yellow-billed Sheathbills (*Chionis alba*) from the Southern Ocean, presented by Mr. H. Roberts; a Wanderoo Monkey (*Macacus silenus*) from the Malabar Coast, presented by Lieut. Vipan; a Rose-crested Cockatoo (*Cacatua moluccensis*) from the Moluccas, presented by Mr. John Elms; three Grey-breasted Parakeets (*Bolborhyncus monachus*) from Monte Video, presented by Mr. C. Purnchard; a King Vulture (*Gyparchus papa*) from Tropical America; a Red-backed Buzzard (*Buteo erythronotus*) from South America, purchased; a Philantomba Antelope (*Cephalophus maxwellii*) born in the Gardens.

ON SPECTRUM PHOTOGRAPHY*

II.

I NEXT come to a very beautiful reflex action of spectroscopy on photography; and now I must take you back to America. I am nearly certain that everyone in this room is perfectly familiar with the name of Rutherfurd in connection with celestial photography: if you will allow me I will point my reference to him by throwing on the screen one of his magnificent photographs of the moon, which he was good enough to give me some little time ago. Unfortunately, I am not able to throw on the screen a photograph of the solar spectrum which we owe to him, the most magnificent photograph—and I say it with the intensest envy—which I think it is possible to obtain. However, I have a copy of it on the wall, and it is well worth inspection. Rutherfurd, whose name is associated with that of Delarue in the matter of celestial photography, was not content with reflectors. He lives in the centre of New York, and I suppose New York is as bad as London for tarnishing everything that the smoke and atmosphere can get at; and he came to the conclusion that he must abstain from celestial photography altogether, or else make a lens—and a lens with Mr. Rutherfurd means something over 12 in. diameter—which should give him as perfect an image in New York with 15 in. of glass, as a perfect reflector of 15 in. aperture would give him as far away from a city as you please. Mr. Rutherfurd, who never minces matters, knowing that it was absolutely impossible to get such a lens as this from an optician, who of course neglects almost entirely the violet rays—the very rays which he wanted—in constructing an ordinary telescope, determined to make such an one himself. He thought about the matter, and he came to the conclusion that in any attempt to correct a lens of this magnitude for the chemical rays, the use of the spectroscope would be invaluable. He therefore had a large spectroscope made, in order to make a large telescope, and then we have just as distinct an improvement upon the instruments which we owe to the skill of those who first adopted the suggestion of Sir John Herschel and brought together the chemical and the visual rays, as the improvement we owe to Herschel was upon the instruments which dealt simply with the visible rays. Mr. Rutherfurd simply discards the visual rays, and brings together the chemical rays; the result of his work being a telescope through which it is impossible to see anything, but through which the minutest star, down I believe to the tenth magnitude, can be photographed with the most perfect sharpness. This is the instrument of the future, so far as stellar astronomy is concerned. Having thus achieved what he wished in the construction of this instrument, and having the spectroscope, Mr. Rutherfurd commenced a research, which, I am sorry to say, he has never published, for it would be of the greatest value to any photographer or any astronomer amongst us, upon various kinds of collodion and upon the best arrangement of lenses for photographing the spectrum. Mr. Rutherfurd found that some collodions which he got were so local in their action as to be almost useless for that reason, and that others were so general in their action that they were also almost useless for the exactly opposite reason. I will now throw on the screen the line G and the lines in the green, or rather the lines approaching to the green near F; with ordinary collodions, such as one generally gets, that is to say, collodions not absolutely good, but free from both the extremes referred to by Mr. Rutherfurd, we want something like five seconds for the part near the line G. Well, when you go a little way along the spectrum in the less refrangible direction, you have to put minutes for seconds—in other words, the exposure has to be sixty times as long. I have another photograph of the spectrum, which will show you the part of the spectrum less refrangible than the line F to which I have referred. This photograph which you see on the screen required an exposure of very nearly half an hour.

Those of you who are most familiar with the solar spectrum will recognise the extreme importance of Mr. Rutherfurd's contribution to photographic spectroscopy, when I tell you that his photograph of the solar spectrum is quite as admirable and excellent as is the photograph of the moon which I have just shown you on the screen. During the last year this question of the solar spectrum has again been considerably advanced by photography in America. Mr. Rutherfurd's photographs, admirable although they are, are refraction photographs, that is to say prisms were used, and, more than this, prisms of glass. You will, therefore, quite understand that the photograph extends only a very little distance beyond the lines H. But America was not satisfied with this, and in the person of Dr. Draper, the son of the Professor Draper whose name is so honourably associated with the commencement of work done in photography thirty years ago, has just now photographed the solar spectrum far beyond H. A copy of his photograph is on the wall, but unfortunately I have not a copy which I can throw on the screen.

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* Continued from p. 112.

I have already referred to the extreme importance of photography in astronomy, and the point that I wish to urge to-night, after what I have stated regarding all the work which has been done up to the present time, is this—That what photography has been in the past to astronomy—what it will be in the future no one can say—such can photography, and such must photography, be to chemists and physicists. Of course, in the way of photographic application, it is scarcely fair to say that a daily photographic record of the prominences around the sun is a question either of physics or of chemistry. But still the method which enables us, or which, I hope, will enable us shortly, to obtain a daily photograph of every prominence which bursts out—although absolutely invisible to our eyes—on the sun, is a method which depends on physical laws, and has nothing to do with astronomy in the ordinary sense. If you will allow me, I will show you now on the screen a photograph of a drawing which was made by an eminent Italian observer in India during the last eclipse. It is a drawing made by Prof. Respighi, of the sun's corona, as seen by the spectroscope; and I hope in the next eclipse we shall not any longer have merely drawings to refer to, but that we shall have a photograph which can be brought here, and which will let us know exactly how the matter stood. You see there on the screen three rings—a red ring, a green ring, and a blue ring. They are red, green, and blue, because the element in that part of the sun's atmosphere—hydrogen—gives us lines in the red, green, and blue; and they are rings because the hydrogen atmosphere extends in the most admirably regular way all round the sun. In fact, we may say that, in observations of this kind, we use the corona instead of the slit, and if that is good for the corona it is perfectly obvious to you it is good for the chromosphere—for the brighter regions lying closer to the sun than the corona does—as we know that it gives a line of intense blue, exactly where photography, as it is generally carried on, has its strongest *point d'appui* in the spectrum; and it is quite clear to you that we ought to be able to get a photograph of this every day, just as easily as we saw it in India during the eclipse.

We will next consider the application of photography, no longer to the mere solar spectrum, but to the physics of the sun. What is the solar spectrum? It is the continuous spectrum of the sun, minus certain portions where the light of the continuous spectrum has been absorbed. What have been the absorbers? The gases and vapours, generally speaking, in an excessively limited zone of the sun's atmosphere, lying close to the bright sun we see; close, I say, to the photosphere. This zone is called the reversing layer. Then if the solar spectrum is the result of the absorption of this reversing layer, what will happen to the solar spectrum if the constitution of the layer changes? Obviously a change in the solar spectrum. Now, recent researches carried on by means of photography show us that if you take any particular vapour in the reversing layer, which you may call A, for instance, and then assume that the quantity of A in the layer is reduced, the absorption of that particular vapour will be reduced; what then will be the result on the photograph of the solar spectrum? Some of the lines will disappear. Suppose that this particular vapour which we call A, instead of being assumed to decrease in quantity, increases in quantity, what will happen to the solar spectrum? The same researches have told us that as its quantity increases its absorption will increase, and that its increased absorption will be indicated by an increase in the number and in the breadth of the lines absorbed. What, then, will happen to the solar spectrum if any change of this kind is going on? The photograph of a solar spectrum taken, say, to-day, may be different from the photograph of the same part of the spectrum taken at some distant period. What is the distant period we do not yet know—whether three months, six months, six years, or eleven years; but, at all events, there is reason to think already that if we had a series of photographs of the solar spectrum, taken year by year, we should see great changes in the spectrum. Allow me to show you a photograph of a very limited portion of the solar question, and I will prove my case; and let me tell you I could not prove my case if photography had not been called in, because if the existence of any particular metal, or of the increase of any particular metal, depends on such a small matter as one line among 10,000, what will happen if a man neglects to observe this change? People will say, "Oh! in a research of that kind it is altogether excusable if he has made a mistake." But if you have a series of phenomena recorded by means of a camera on "a retina which never forgets," as Mr. Delarue has beautifully put it, and if you compare those pictures day by day, and year by year, the thing is put beyond all question when you get one line disappearing, or another line appearing.

Now we have before us a part of the solar spectrum near the line H, and I wish to call your particular attention to one line. We have admirable drawings of the solar spectrum taken about the year 1860. If the draughtsman was recording by means of his eye the lines in the spectrum, he would not be very likely to overlook a line darker than some he inserts, but he might easily overlook finer lines. Now, it is a fact that in the most careful map that we have—a map drawn with a most wonderful honesty and splendid skill—a line is absent in the region indicated, which line is now darker than some that were then drawn, and that line indicates the presence of an additional element in the sun—strontium. I do not make this assertion thinking that subsequent facts will show the drawing to be wrong, but because I see reason to believe that what we know already of the sun teaches us that it is one of the most likely things in the world that strontium was not present in such great quantity in the reversing layer when the drawing was made; but, however that may be, I think you will see how important it is that this photograph, which I have just thrown on the screen, should be compared with photographs made five, ten, fifteen, a hundred, or two hundred, or as many years as you like ahead, and it is in this possible continuity of observation of the solar spectrum, carried on for centuries, that I do think we have in photography not only a tremendous ally of the spectroscope, but a part of the spectroscope itself. Spectroscopy, I think, has already arrived at such a point, at all events in connection with the heavenly bodies, that it is almost useless unless the record is a photographic one. I am glad to say that only to-day I have had a letter from Dr. Draper, who tells me he has at last succeeded in getting an admirable photograph of the spectrum of a star. Now that is of the very highest importance, because the sun is nothing but a star, and the stars are nothing but distant suns; and as long as we merely investigate the sun, however diligently or admirably we do it, and neglect all the others, it is as if a man who might have the whole realm of literature to work at should confine himself to one book, and that book probably not a good representative of the literature of the country he was examining into.

So much for the application of photography to what may be called the celestial side of spectroscopy; but let me tell you that this, so far as spectroscopy is concerned, does not exist. To the spectroscope all nature is one, and it is absolutely impossible to make a single observation, either on a sun, or a star, or a comet, without bringing chemical and physical considerations into play; and it will be a regrettable circumstance if chemists employ the spectroscope in terrestrial chemistry—they have not done much in that way yet—without taking the sun and all the various stars of heaven into counsel, because the spectroscope is absolutely regardless of space, and shows us that the elements which are most familiar to us here, or at all events a good many of them, are present in the most distant stars, and the spectroscope shows us those elements existing under conditions which are absolutely impossible here.

There is another point, too—spectroscopy is, above all things, molecular. We are dealing with the ultimate atoms, or molecules, or whatever you like to call them, when, by means of the spark, we drive a substance into vapour. And if chemists, for instance, will simply ask themselves which substances have their lines reversed in the solar spectrum, I think, before they have thought that problem out—that very simple problem, as it seems—there will be such a flood of light thrown upon terrestrial chemistry, that the only wonder will be that it has not been seen before, years and years ago. These, you will say, are theoretical applications. It is perfectly true; and there are a great many other theoretical applications that it would be my duty, as it would be my pleasure, to bring before you, if time permitted. But that is not all. I have to refer to the application of the spectroscope in what are considered by some people more practical directions. The more you deal with the most abstruse considerations of Science, the more likely you are to get practical applications out of them.

You have already seen how exceedingly important it was to use a slit instead of a round hole in these experiments. It was the verdict of Wollaston, and it was the verdict of Becquerel and Draper, as I have shown you to-night with regard to photography. You have also seen that we can use the circular corona as a slit equally well.

Now if we take a long slit and divide it into as many portions as we choose, we see at once the improvement that we introduce into spectroscopic photography. All we have to do is to divide that slit into portions, as it were, by letting a window run down the slit, and when the window has arrived at the second part of the slit, let in light from a new source. This principle has been carried out practically in the following manner:—A rectangular brass plate 71 mm. long, and 35 mm. broad, slides in grooves in front of the slit of the spectroscope, and a window 4 mm. high, cut out of this plate, leaves a portion of the slit of this length exposed. A small pin presses firmly against the face of one of the sliding plates, and a row of small shallow holes or notches is drilled in the plate so as to intercept it in its upward or downward movement at those points where the pin falls into a notch. The distance between the notches is precisely the same as the height of the opening cut in the sliding plate, so that the movement of this plate from one notch to another corresponds to a distance equal to the height of the exposed part of the slit, and the spectra compared are confronted, so to speak, absolutely; the upper edge of one spectrum abuts against the lower edge of the other, and the coincidence, or want of coincidence, between lines in the two spectra can thus be determined with the greatest precision. The spectroscope employed contains three prisms of 45° and one of 60°; its observing telescope is replaced by a camera with a 3-in. lens by Dallmeyer of about 23 in. focal length for the use of which I am indebted to Lord Lindsay. With this arrangement—the spectrum being received upon a sensitised ¼ plate—the portion between the wave-lengths, 3,900 and 4,500, can be obtained at once in good focus. A ray of sunlight, reflected from a heliostat mirror so as to fall upon the slit-plate, is brought to a focus by means of a double convex lens just between the carbon poles of an electric lamp, while a second convex lens placed between the lamp and the collimator tube, serves to cast an image of the sun or of the electric arc upon the slit-plate. Supposing, now, we wished to compare the iron spectrum with that of the sun: the sun's image in sharp focus on the slit-plate is first allowed to imprint its spectrum on the prepared plate. The ray of sunlight is then cut off, the sliding plate moved up or down till the pin catches in the next notch, and the image of the arc, passing between an upper pole of carbon and a lower pole consisting of a carbon crucible containing a fragment of iron, is allowed to fall on the portion of the slit thus exposed.

Let me show you some photographs illustrating this description. Here is a single photographic plate on which the new method has enabled us to register no less than four different spectra; those of you who are familiar with photographic processes will immediately see how it is that the number is not forty instead of four. Having a slit of a certain length, if I open all the length of that slit at once I should get a spectrum the breadth of which would depend upon the length of the slit; but if I commence operations by allowing the light first to come through one small portion of the slit, then we shall get the light from the particular metal which I employ in the electric arc falling on one part of the plate, and registering itself on the photographic plate. Then, if I close up that part of the slit, and open another one, I shall be able, through that newly opened part of the slit, all the rest being closed, to photograph on the plate the spectrum of another substance, say iron. Then, having used up that part of the plate, I can close that portion of the slit, I can bring my window lower down, and there we have the spectrum of cobalt. The window has been brought farther down, and there we have the spectrum of nickel, so that we have, as the work of some eight or nine minutes at the outside, a photograph—not a perfect one in this case, but this was the first one taken on this method—which will register with the most absolute and complete accuracy and certainty not less than 1,000 lines. Now a careful student of those lines, working as hard as he can, thinks himself very fortunate if he can lay down ten an hour. Therefore, as ten an hour are to 1,000 in seven minutes, so is the eye to photography in these matters.

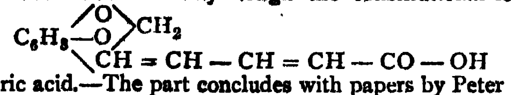
I have a photograph of a somewhat similar nature, which I am anxious to place before you. We have here an absolute comparison rendered possible, by means of photography, between the lines of the spectrum of iron and the lines of the spectrum of the sun. You see that in the case of most of the thick lines, you get a thick line in the solar spectrum corresponding with the lines of the iron. And, more than this, you see, I hope, all of you, that these lines of iron are of different lengths. The reason of that is that I have been careful to photograph on the plate the lines due to the various strata of iron vapour, from the rarest vapour, which is obtained at the outside of the electric arc, to the densest, which occupies the centre of the core, and you will see the most beautiful gradation as we pass from the outside part of the spectrum to the inside. This inside part represents the complete spectrum of the core, and the outside the incomplete and almost mono-chromatic spectrum of the vapour which surrounds the denser core in the middle of the spark; thus we have practically reduced the spectrum of iron to one line, instead of 460. That is the first photograph of the kind which has been taken; I say that, not because I am proud of it, but because you all know how enormously photographic processes are likely to be developed the moment, not one individual, but a great many, try their hands upon them, so that an enormous improvement upon what you now see may be anticipated. Not only have we developed, in the application of photography to spectroscopy, a valuable ally to Science, as we have in the application of photography to astronomy—and you know what that has done, and what it is going to do—but we have, I believe, what we may almost call a new chemistry, some day to be revealed to us by means of photographic records of the behaviour of molecules. Recollect that the difference between the iron spectrum of one line and the iron spectrum of between 400 and 500 lines is simply due to the difference in the arrangements of the molecules or atoms of iron in the centre of the electric arc and its exterior. There is one question which all lovers of the spectroscope may ask of photographers, and that is this, why should we any longer be confined, in registering spectra, to the more refrangible end of the spectrum, when one of the very first spectra of the sun that was ever taken was a complete photograph of the spectrum, including not only the blue, the green, and the yellow, but the red, and the extreme red? I think that if photographers will study the action of light on molecules, and read that extraordinary paper of Becquerel's, and will give those who are familiar with the spectroscope, and those who are anxious to promote the progress of spectroscopic research, a means of extending photographic registration, not only into the green part of the spectrum, which they do already with difficulty, but to the extreme red, then the use of the eye will almost entirely be abolished in these inquiries. And although no one has a higher estimate than myself of the extreme importance of the eye, I think that the more it is replaced by permanent natural records in these inquiries, the better it will be for the progress of Science.

J. NORMAN LOCKYER

SCIENTIFIC SERIALS

THE current number of the *Quarterly Journal of Microscopic Science* contains several papers of interest. Dr. Michael Foster commences with an article On the term Endothelium, in which he proves that the word is etymologically pure nonsense, Ruysch's word epithelium signifying that it covers papillæ. His endothelium must be understood to mean *that it is inside a papilla.* It is also valueless for other reasons: for if it is defined as that epithelium developed from the germinal mesoblast, the epithelium of the Wolffian ducts, of the ureters, and of Muller's ducts would have to be included. Therefore the term is insignificant and must be abolished. *Monoderic* and *polyderic* are proposed as terms to indicate that the cells form one or several layers.—The second part of Prof. Haeckel's interesting Gastræa theory follows, in English. In it the systematic and the phylogenetic signification of the Gastræa theory and the ontogenetic succession of the system of organs are discussed, as well as the bearing of the whole on the theory of types. The author is so prolific in his introduction of new words, the definitions of many of which are to be found in other publications, that a Haeckel Glossary in the next number of the *Journal* would not be out of place, to assist readers in the full appreciation of that illustrious biologist's very suggestive theory.—Mr. J. W. Groves explains his method of arranging and cataloguing microscopic specimens.—A paper follows by Mr. E. C. Baber On picro-carminate of ammonia as a microscopic staining fluid, in which he explains M. Ranvier's method. The great advantage of this reagent is shown to consist in its staining tissues in a series of colours varying from red to yellow; it also acts rapidly and can be kept in a dry form.—The Rev. E. O'Meara describes a collection of Diatomaceæ from Spitzbergen, including many species not enumerated by Cleve's Diatoms ot the Arctic Sea.—Mr. Buck describes and figures a new Polyzoon belonging to the family *Halcyonelea*, named by him *Clavopora hystricis*, from a single specimen obtained in the expedition of the *Porcupine* in the Mediterranean.—An article from the *Indian Medical Gazette*, On the etiology of Madura foot, is discussed, the vegetable origin of that disease being severely handled. A note by the Rev. M. J. Berkeley is appended, strongly supporting Dr. V. Carter's original observations.—Dr. W. G. Farlow, of Harvard University, writes On a sexual growth from the prothallus of *Pteris cretica*, in which he shows that whilst n some of the prothalli archegorina and antheridia were deveoped, others gave rise to young fern-plantlets by a direct budding of the cells, without any sexual intervention. The paper is llustrated with two plates.—Mr. E. R. Lankester has two papers, one on *Torquatella typica*, a new type of Infusoria, allied to the Ciliata, from Naples; peculiar in not possessing cilia, not even round the oral region and capitular prominence, but in their place a bell-like prolongation of the body-wall like a ring of united cilia. The second paper is on the heart of *Appendicularia furcata*, in which that organ is shown to consist of two nucleated cells connected by fourteen or so slender vibratile fibrillæ, whose mutual connection by a membrane is uncertain. This organ is thus nothing more than a "most vigorous churn, beating and stirring up the fluid in the great perivisceral hæmoymph space without propelling it in any particular direction." The paper ends with some suggestive remarks on the reduction of the structure of organs in diminutive elaborate types generally.

Justus Liebig's Annalen der Chemie und Pharmacie.—Band 72, Heft 2.—The following papers are published in this part:—On the salts of parabanic acid, by N. Menshutkin. The formula of the ammonium salt is $C_3H_2N_2O_3.NH_3$; by the action of water on the salt the ammonium salt of oxaluric acid is produced, and by the action of heat alone oxaluramide. The potassium and sodium salts have likewise been examined and two silver salts obtained, of which the formulæ are $C_3HAgN_2O_3.H_2O$ nd $C_3Ag_2N_2O_3.H_2O$.—The same author contributes a paper entled, "Notice on potassium oxalurate and the determination of he alkaline metals in the salts of the acids belonging to the uric cid group."—On the oxidation products of colophony and oil of urpentine, by Dr. Josef Schreder. By digesting colophony with ilute sulphuric acid, isophthalic acid ($C_8H_6O_4$) and trimellithic cid ($C_9H_6O_6$) are obtained. Turpentine oil oxidised by dilute itric acid, gives terebinic and terephthalic acids.—On the conersion of cinchonidine into an oxy-base, by Dr. J. Skalivert. Cinchonidine is mixed with carbon disulphide and bromine ropped into the mixture. A brominated compound of the ormula $C_{20}H_{22}Br_2N_2O$ is thus obtained, which on treatment with potassium hydrate yields the new oxy-base $C_{20}H_{24}N_2O_2$. Analyses of the sulphate and of the double Pt salt are given.—On ferrous anhydrosulphate, by T. Bolas, already noticed in the ournal of the Chemical Society.—The following are commuications from the Tübingen laboratory:—(1) On the cyan- and arboxyl derivatives of diphenyl, by Oscar Doebner.—(2) On normal phenyl propyl alcohol and allylbenzene, by Leopold Rügheimer.—(3) Researches on the synthesis of allylbenzene, by Rudolf Fittig.—(4) Researches on the constitution of piperine and its decomposition products piperic acid and piperidine, by R. Fittig and W. H. Mielck. This is the fourth notice on the ubject, and the authors now touch upon the constitution of piperic acid. By the action of bromine a tetra-brominated acid $C_{12}H_{10}Br_4O_4$ is obtained which by the action of sodium carbonate s converted into the dibrominated compound $C_{12}H_8Br_2O_4$. This ast substance boiled with soda solution and precipitated by an acid yields a monobrominated body of the formula $C_{12}H_8BrO_5$. The authors next proceed to the consideration of a new acid which they have obtained by acting upon monobrompiperonal with bases, and then decomposing the salt produced by means of hydrochloric acid. The new acid has the formula $C_{12}H_{10}Br_4O_5$, and must be regarded as the substitution product of the acid $C_{12}H_{14}O_5$. By the action of soda on the sodium salt of the new acid an intermediate compound having the formula $C_{12}H_8Br_2O_5$ has been produced. Bromine dropped into a solution of hydropiperic acid in carbon disulphide, gives rise to the formation of the compound $C_{12}H_{12}Br_2O_4$. In the concluding section the decomposition of hydropiperic acid by means of fused potassium hydrate is treated of. The chief product of the reaction is protocatechuic acid, $C_7H_6O_4$, H_2O. The authors finally assign the constitutional formula



$$C_6H_3\begin{cases}-O\\-O\end{cases}\!>CH_2\quad \backslash CH = CH - CH = CH - CO - OH$$

to piperic acid.—The part concludes with papers by Peter Greiss On the sulphurisation of sulphurobenzoic acid or dicarboxylsulphocarbanilide, and by M. G. Gustavson On tetra-iodide of carbon. This substance has been obtained by the action of aluminic iodide on CCl_4 according to the equation—

$$3CCl_4 + 2Al_2I_6 = 2Al_2Cl_6 + 3CI_4.$$

The substances are made to react in carbon disulphide solutions.

Gazzetta Chimica Italiana, Fascicolo V., 1874. This part contains the following papers:—On the extraction of sulphur, by F. Sestini.—On the action of sulphur on earthy carbonates, particularly on neutral calcium carbonate, with regard to geology and agriculture, by Prof. Egidio Pollacci. This paper was communicated in April to the Reale Istituto Lombardo di Scienze e Lettere. The author's principal object is to prove that a mixture of sulphur and calcium carbonate acted upon by water with free access of air gives rise to the formation of calcium sulphate. The chemical changes are thus expressed—

$$2S + 3O_2 + 2H_2O = 2H_2SO_4$$
$$2H_2SO_4 + 2CaCO_3 = 2CaSO_4 + 2CO_2 + 2H_2O.$$

The author is of opinion that the oxidation of the sulphur is effected *directly* by atmospheric oxygen in presence of $CaCO_3$ and water.—The concluding paper is entitled Chemical Research on Turkey Red, by Prof. Abelardo Romegialli. The remainder of the part is devoted to abstracts from foreign periodicals.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, July 1.—This number contains an article by Dr. J. Hann On the diminution of atmospheric vapour with increase of elevation. Experiment and mathematical theory both deny the existence of an independent vapour atmosphere, which according to Dalton's law would decrease much less rapidly with elevation than atmospheric vapour really does. Hence Mr. Strachey (Proceedings of the Royal Society, March 1861) would not deduct the vapour pressure from the height of the barometer to obtain the pressure of dry air. From a table showing the actual decrease of vapour tension with increase of height, observed in various ascents of mountains and in balloons, is derived a formula to express this decrease. Thus where p and p_0 stand for the pressures at the height h and at the surface of the earth, h being measured in units of 1,000 English feet,

$$(1)\ p = p_0\,(1 - 0{\cdot}075\,h + 0{\cdot}00146h^2)$$

and where e is the bases of natural logarithms, and h in units of 1,000 metres,

$$(2)\ p = p_0\,10 - \frac{h}{6517} = p_0 e - \frac{h}{2830}$$

If atmospheric vapour obeyed the law of Dalton, its weight over any place would be four and a half times greater than the real weight. Dr. Hann calculates the weight of vapour at 1,962 metres to be only half, at 6,500 metres one-tenth, of the weight at the surface of the earth. With respect to this rapid decrease of moisture, Strachey remarked that mountain chains, even of moderate altitude, must have great influence upon the hygrometric state of the atmosphere. The above formula can only be used safely for calculating the *mean* pressure of vapour at a given height. It may be useful for barometric measurements of altitudes, since it frequently happens that the vapour pressure of only one of two stations, of which the difference in height is required, is known. Observed values, up to 1,884 metres, have been actually found to agree well with those calculated by the formula. This formula may be only another expression for the opinion of Strachey, that the mean degree of saturation at different heights remains nearly uniform, and therefore the vapour tension depends merely on decrease of temperature. But the calculation of the mean vapour pressure of one level from that of another level with so great accuracy appears not to have been hitherto accomplished.

Annali di Chimica applicata alla Medicina, t. lviii., No. 5.—In dietetics there is a paper by Dr. F. Turbacco On cheese and its alimentary use.—Beaumertz furnishes a contribution on farinaceous substances as food for children.—In pathology there is a paper by Dr. L. Ledeganck (translated from *La Presse Médicale Belge*) On the action of parasitic organisms in the production of necrosis.—In therapeutics we have the following papers:—On the anæsthesia produced in man by the injection of chloral into the veins, by Oré.—Under the heading "Varieties" there is a paper by Prof. Fausto Sestini On the chemical composition of mulberry leaves; one On a new method of extracting logwood for vines and inks, from the agricultural chemical laboratory of Bologna, directed by Prof. A. Casali and Francesco Marconi; and, finally, a contribution by Melsens On the use of solutions of sulphurous acid, of neutral acid and sulphites, and of hyposulphites.

SOCIETIES AND ACADEMIES

London

Royal Society, June 11.—Researches in Spectrum Analysis in connection with the spectrum of the sun.—No. IV., by J. Norman Lockyer, F.R.S.

Maps of the spectra of calcium, barium, and strontium have been constructed from photographs taken by the method described in a former communication (the third of this series). The maps comprise the portion of the spectrum extending from wave-length 3900 to wave-length 4509, and are laid before the Society as a specimen of the results obtainable by the photographic method, in the hope of securing the co-operation of other observers. The method of mapping is described in detail, and tables of wave-lengths accompany the maps. The wave-lengths assigned to the new lines must be considered only as approximations to the truth. Many of the coincidences between lines in distinct spectra recorded by former observers have been shown by the photographic method to be caused by the presence of one substance as an impurity in the other; but a certain number of coincidences still remain undetermined. The question of the reversal of the new lines in the solar spectrum is reserved till better photographs can be obtained.

Royal Horticultural Society, July 1.—Scientific Committee. Dr. Hooker, P.R.S., in the chair.—Dr. Gilbert described the results of some investigations made by Mr. Lawes and himself on the conditions of the development of fairy rings. The mycelium of the fungus which produced the rings accumulated nitrogen in the superficial layers of the soil with the result of stimulating the growth of the grass and giving it the dark green colour which is characteristic of vegetation richly supplied with nitrogenous nutriment. When this luxuriant growth was grazed off, the soil was left relatively poor in nitrogen, and it was accordingly found that the superficial soil inside the rings was poorer in nitrogen than that outside it.—Dr. Hooker stated that seeds of the Kerguelen's Island cabbage (*Pringlea antiscorbutica*) sent to Edinburgh in a sealed bottle had germinated, while those sent to Kew in boxes had altogether failed. The following communication from Mr. Darwin was read:—"The leaves of *Pinguicula vulgaris* possess a power of digesting animal matter similar to that shown by the sundews (*Drosera*). Albumen, fibrin, meat or cartilage induce a secretion from the glands of the upper surface of the leaf, and their secretion becomes feebly acid (but not so much so as that of *Drosera*). Their secretion is reabsorbed, and causes an aggregation of the protoplasm in the cells of the glands, such as had been observed in other similar cases. Before excitement the glands were seen to be filled with a homogeneous pale greenish fluid; after the aggregation of the protoplasm it can be seen to move. When a row of insects or of cabbage seeds are placed near the margin of a leaf (or when a single insect is placed at one point), the whole margin (or one point) becomes curled considerably over in two or three hours; the apex of the leaf will not turn over towards the base. Small fragments of glass also cause a similar movement, but to a much less degree. The inflexed margin pours forth a secretion which envelops the flies or seeds, but pieces of glass cause no, or hardly any, increase of secretion. But here comes a puzzle: if the flies or fly be removed, the margin of the leaf turns back in less than twenty-four hours; but it does so also when a row of flies and cabbage seeds are left adhering; so that the use or meaning of the inflexion is at present quite a puzzle."—Mr. W. G. Smith showed engraved wood blocks of lignum vitæ, which he found more brittle than box.

Vienna

Imperial Academy of Sciences, Feb. 26.—Dr. Urba communicated a paper on some rocks of South Greenland, collected by Prof. Laube, from the second German Polar Expedition.—M. Pelz presented a memoir on determination of the axes of conical surfaces of the second order.—Dr. Adolph Meyer gave an account of new and little-known birds of New Guinea.—Dr. Exner read a paper on the employment of the ice-calorimeter for determining the intensity of the solar radiation; describing an apparatus by which the intensity may be measured directly in calorics, without (as in the Pouillet pyrheliometer) a change of temperature in the instrument, rendering correction necessary.—Dr. Brauer communicated a note on the development and mode of life of *Lepidurus productus* Bosc.—MM. Schulhof and Holetschek communicated the elements and ephemerides of a comet discovered on Feb. 20 by Prof. Winnecke at Strassburg.

Paris

Academy of Sciences, July 20.—M. Bertrand in the chair.—The following papers were read:—Note on the action of two current elements, by M. Bertrand. The assertion that two elements of the same direction attract one another is shown to be inexact, even for parallel elements, and does not agree even with Ampère's law. The author has solved the following problem:—A current element being given, to find in a point of space M the direction that must be assigned to another element, that their mutual action may be attractive, repulsive, or *nil*.—Extract from the Report of the Commission of the Agricultural Society of Chalon-sur-Saône, in the department of Saône-et-Loire, on Phylloxera, by M. Boully.—Reply to a criticism by M. Garrigou, contained in a recent note entitled "Carboniferous Limestone of the Pyrenees; Marbles of Saint-Béat and of Mont," by M. A. Leymerie.—On the efficacy of the method of submersion as a means of improving the vine in the Crimea: extract from a letter from M. Boutin to M. Dumas.—Employment of the *résidues d'enfer* of the oil-mills against *Phylloxera*, by M. Rousseau.—Third note on the electric conductivity of ligneous bodies, by M. Th. du Moncel.—On the stratification of the electric light, by M. Neyreneuf.—On the passivity of iron, by M. A. Renard. The author described several experiments illustrative of methods by which iron can be made passive in ordinary nitric acid.—Action of chloroform on sodic acetatic ether, by MM. A. Oppenheim and S. Pfaff.—The product of the reaction was saponified by soda and then acidulated with HCl. A new acid of the formula $C_9H_8O_5$ is thus obtained. This acid is dibasic and belongs to the aromatic series, the authors considering it an isomer of uvitic acid, the substituted groups occupying the positions 1 : 2 : 4.—On the isomeric compounds C_2H_4IBr, by M. C. Friedel. The author has repeated the experiments recently published on this subject by M. Lagermarck, and concludes therefrom that no third isomer of this formula exists.—On a development of heat produced by the contact of sodium sulphate with water at temperatures when the known hydrates of sodium sulphate cannot exist, and when the saturated solution of the salt deposits it only in the anhydrous state, by M. de Coppet.—Ethers of normal propylglycol, by M. E. Reboul.—Experiments on the generation of proto-organisms in media protected from aërial germs, by M. Onimus.—Indifference in the direction of the adventitious roots of a cactus, by M. D. Clos.—Observation of a bolide on the evening of July 18, at Versailles, by M. Martin de Brettes.—On the composition of potassium permanganate, by M. E. J. Maumené. The author concludes that the formula of the salt is Mn_2O_7KO.—New method of determining metals or oxides, by the same author.

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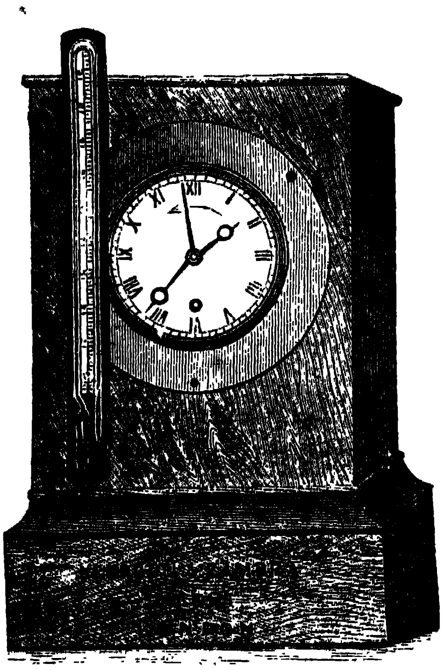

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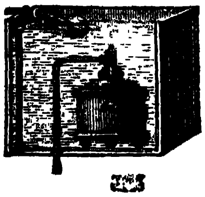

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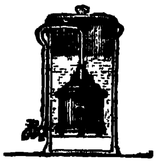

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THURSDAY, SEPTEMBER 3, 1874

*FIFTH REPORT OF THE SCIENCE COMMISSION**

II.

SO much has been written recently here and elsewhere on the origin and growth of the admirable Owens College, Manchester, that we shall not repeat the details on these points furnished by the Report of the Commission. Since it was opened in 1851, it has held its way through many discouragements, and now, despite its comparatively narrow income, it is, at least from the point of view of scientific teaching and research, one of the most efficient institutions in the kingdom. Considering its comparatively recent origin and its provincial situation, the gifts bestowed upon it have been almost lavish; and yet the same complaint is made in the case of the Manchester College as is made by the two London institutions: the efficiency of the work of the College, and especially of its scientific side, is seriously crippled from want of adequate resources.

The whole endowments of the College, from its foundation till the present time, have amounted to 34,582*l.* In connection with the recent movement for the erection of new buildings, including various general and special endowments, an additional 168,300*l.* has been obtained; but even this is short by 60,200*l.* of the sum required to carry out the proposed extensions. With the prospect of this deficiency the Governors of the College cannot at present undertake the establishment of any new chairs. If, however, they had adequate resources, it has been stated that they would probably proceed to divide the professorship of English and its History, and to found new chairs of Mixed Mathematics, of Applied Geology and Mining, of Astronomy and Meteorology, and of Architecture.

The total number of students in Owens College in 1873-4 was 356, being an increase of 19 on the previous year, and excluding 140 students belonging to the Medical School.

The number of students entering the evening classes in 1872-3 was 557, which in 1874 rose to the very large number of 889.

With regard to the Owens College, the Commission makes the following recommendation:—

"Considering the strenuous and persevering efforts made by the great commercial community by which the Owens College is surrounded, and the cordial sympathy which these efforts have evoked, and which has manifested itself in the incorporation of other societies and schools with the College, and in the subscriptions and benefactions for special objects by which the exertions of the governing body have been seconded; we are of opinion that this institution has established a claim to aid from the national funds. We therefore recommend, in accordance with the views which we have expressed with regard to the two metropolitan colleges, that the Owens College should receive assistance from Government both in the form of a capital sum to be regarded as a contribution towards its building fund, and also in the form of an annual grant in aid of its working expenses, with the especial view of enabling it to complete the curriculum of studies by the establishment of new chairs."

The Newcastle College of Physical Science originated in a feeling on the part of the authorities of the University of Durham, that that University did not completely meet the educational wants of the North. To render the University more generally useful, it was thought that the best step that could be taken would be to establish a School of Physical Science in connection with it. Newcastle, as the site of this school, was preferred to Durham, in deference to the wishes of all the eminent local employers of labour.

The College was founded in 1871 for the teaching of physical science, particularly in its practical application to engineering, mining, manufactures, and agriculture. The funds necessary for its endowment were provided in part by the University of Durham, which gave, in the first instance, 1,000*l.* a year in perpetuity, which has since been increased; and, in part, by a subscription raised in the north of England.

From local sources, and by amalgamating with the College the other scientific institutions of Newcastle, 117,000*l.* may be obtained.

The amount originally subscribed was of course insufficient to provide buildings for the new institution, and the College has at present to pay rent for the premises which it occupies. It is the opinion of the witnesses that it is extremely desirable that the College should be provided with buildings of its own. Sir William Armstrong says: "We consider the present accommodation as a makeshift, but without Government assistance it would be scarcely possible to undertake" to provide separate buildings appropriated solely to the College.

It was proposed, in the first instance, to provide four professorships, viz., of Pure and Applied Mathematics, of Chemistry, of Experimental Physics, and of Geology. To these professorships, lecturers have been added in literary subjects, in Greek and Latin, in English History and Literature, in French, and in German, besides a lectureship in Mechanical Drawing. It is thought very desirable by the founders of the College that other professorships of Science should be added to those already founded; indeed, a professorship of Biology has been recently established.

The number of students in 1873-4 was 78. The course of study is one of two years, there being two examinations, one at the end of each year; the candidates who pass the formal examination in Physical Science at the end of the second year to receive the title of Associate in Science of the University of Durham.

"There appears," the Report states, "to be every reason to think that the Newcastle College of Science is serving a most useful purpose in its own neighbourhood. There can be no doubt that local colleges in the great centres of manufacturing industry are in a position to meet local requirements which central institutions in London or the national universities are unable to do.

"According to Sir Wm. Armstrong the character of the instruction should be mainly, or almost entirely, of a purely scientific character, because at present there is no difficulty as regards practical knowledge, while on the other hand there is no means of acquiring scientific knowledge.

"The claims which the promoters of the College consider themselves to have upon the Government for assistance are founded upon the national usefulness of the institution, and on the amount of local support which it has received. Sir William Armstrong's view is that the promoters 'have a very sound claim upon the Government, considering how liberally the scheme has been supported locally. I think it would be a very fair thing if the Government, considering how much the nation benefits from the establishment of such colleges, in every case were to contribute a sum proportional to what has been raised in the locality towards the attainment of the object.' . . . .

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* Continued from p. 332.

"We concur to a considerable extent in the opinions expressed by these witnesses. The degree of success which has attended the College of Physical Science at Newcastle-upon-Tyne, both in the collection of local subscriptions and in the organisation of its system of instruction, leads us to express with confidence the hope that by further efforts of the same kind it will before long be placed in a position to establish its claim to assistance from the State."

With regard to the Catholic University of Ireland, while the Commission believes that it is calculated to do much good to the cause of scientific education, it cannot recommend Government to grant it any endowment.

"On a review of the evidence," the Report states, "we are satisfied that the establishment of the Scientific Faculty of the Catholic University has not been without advantage to the instruction of the Irish people, an advantage which might be considerably increased if this faculty could be more completely organised, and its professors increased in number and supplied with adequate means for practical teaching. And we have not failed to observe that at the present time fresh efforts are being made by the persons interested in this institution, to improve and to render more widely available the instruction afforded by it.

"It is also indisputable that the Catholic University has received, and still continues to receive, a large amount of pecuniary support. The permanency, however, of this support, which proceeds, to a large extent at all events, from annnal subscriptions levied by clerical agency, cannot be predicted with any certainty.

"The peculiar organisation of this institution," the Report concludes, "the religious restrictions imposed upon the selection of scientific professors and lecturers—restrictions the removal of which it would be idle to anticipate; the incompleteness of a large portion of its arrangements for the teaching of science, and the uncertainty of its income, preclude us from recommending that it should receive a grant from public funds."

The general outcome, then, of the Fifth Report of the Science Commission is, that University and King's Colleges, London, and Owens College, Manchester, ought certainly to receive assistance from Government, that the Newcastle College is in a fair way to prove that it deserves such assistance, and that it would not be advisable to subsidise the Catholic University of Ireland, as it is at present constituted. J. S. K.

THE APPLICATION OF THE LAWS OF SELECTION TO AGRICULTURE

IN every phase of life the law of selection comes into play. At one time it is natural, at another time it is more or less artificial. At every time, and in every place, we see evidence of the plastic character of the materials on which the vital principle operates.

In devoting my holidays to an agricultural tour in England this season, I have visited several seed-growers who are conferring great advantages on the public by careful selection of parent-plants. I can speak on this point with the experience which a wide range of observation gives. I have myself, by selection, doubled the quantity of solid matter in turnips, and nearly doubled the number of seeds in ears of wheat.

If the principle of selection were universally applied with skill and care in the raising of our seed corn, what an enormous increase would thereby be made to the wealth of the agricultural classes of Great Britain and Ireland!

In our agricultural live stock a series of results, which are truly marvellous, have been accomplished by selection. And yet the principle is understood or practised only by a very small percentage of our farmers.

If any reader wishes to understand in a general way the change that has been made within the last quarter of a century, which is the measure of the life-time of the Royal Agricultural Society of England, let him take the Society's prize lists of 1839 and 1874. In the interval, several new breeds of sheep and cattle have come to be recognised as having distinct types. Nature has had her share in the work. The soil and climate of every district impress certain characters and qualities on the animal; and, in his artificial selection, the farmer preserves these in whole or part. In studying, some years ago, the origin of the older breeds, I was much struck with the extent to which their distinctive characters were due to the natural conditions under which they rose. And in a recent inquiry into the history of the newly-established breeds, the same leading truth has become still plainer.

To give point to this short paper I derive an illustration from the influence exercised on the art of sheep-breeding by the remarkable change which, common observation tells us, has taken place in the material of garments in common use. I refer to the well-known fact that tweeds and coarse cloths are now much more commonly used than in the last generation. To meet the demand thus created the farmer has produced sheep which carry wool of longer staple than the old breeds.

My argument is well illustrated in the great plains in the west of Ireland, where the flock-owners have established a splendid new breed, called the Roscommon Sheep. In the production of this variety the breeder has of course exercised his skill in selection. He crossed Leicester tups of the very best English strains of blood with the native ewe; and he repeated this over and over again until he obtained an animal of the type which suited him. Nature aided him in his art. It may be safely asserted that some of the peculiarities of the wool, as well as some of the peculiar conformations of the body, have been the work of Nature. And it is in retaining what was so well done by Nature that the highest skill is manifested. In England the best example of the argument is possibly afforded by the Lincoln breed of sheep, which stands so deservedly high in public estimation, affording as it does great weight of carcase with a remarkably heavy fleece of lustrous wool. Then, again, let us take the dark-shaded breeds—South Down, Shropshire Down, Oxford Down, and Hampshire Down. The South Down used to be more popular than it is now. It has been giving way in many places to an animal with a larger frame and with a fleece longer in the staple. The first that arose to displace it was the Shropshire, which has been followed by the Oxford Down. Each of these breeds pays best under a given set of circumstances; and this only shows the wide field open to British farmers for profiting by the laws of selection.

I look to the development of this great principle as one of the soundest and surest means of promoting the interests of the agricultural classes.

THOMAS BALDWIN

DARWIN'S "CORAL REEFS"

The Structure and Distribution of Coral Reefs. By Charles Darwin, M.A., F.R.S., &c. Second edition, revised. 1874; pp. 268. (Smith, Elder, and Co.)

THE rising generation of naturalists and geologists has not had, and most probably will never have, such feelings of intellectual pleasure as fell to the lot of the first readers of Charles Darwin's book on Coral Reefs, which was offered to science more than thirty years since. The recent researches into the nature of the deposits of the deep sea, and the discoveries of the bathymetrical zones of water of very different temperatures, are certainly full of vast interest, and will afford the data for the development of many a theory; but the clear exposition of facts, and the bold theory which characterised the book on Coral Reefs, came unexpectedly and with overpowering force of conviction. The natural history of a zoophyte was brought into connection with the grandest phenomena of the globe—with the progressive subsidence of more or less submerged mountains, and with the distribution of volcanic foci. The forces of the organic and inorganic kingdoms were shown to unite in the production of those circular growths of coral which appeared to rise from profound oceanic depths; and it was made evident that the existence and persistent growth of fragile Porites and *Madreporæ* were dependent upon movements of the crust of the globe, the result of forces acting almost from the beginning—upon movements so vast, equable and slow, that over thousands of square miles the coral grew upwards, whilst the supporting rock, its base, and the mother crust subsided in a wonderful unison. The pristine condition of the globe was in fact brought in relation with the formation of those beautiful islands, the theme of romance and poesy, the delight of the missionary, the dread of the navigator, and which should be, according to Dana, the luxurious home of enervated and used-up investigators.

The theory of the formation of barrier reefs and atolls is stated with Darwin's usual lucidity:—"From the limited depths at which reef-building polypifers can flourish, taken into consideration with certain other circumstances, we are compelled to conclude that both in atolls and barrier reefs the foundation to which the coral was primarily attached has subsided; and that during this downward movement the reefs have grown upwards." "There is not one point of essential difference between encircling barrier reefs and atolls; the latter enclose a simple sheet of water; the former encircle an expanse with one or more islands rising from it. Remove the central land, and an annular reef like that of an atoll in an early stage of formation is left." It was necessary, in order that this theory should be valid, that the depth at which reef-building corals can exist below the surface should be ascertained, and also that direct or indirect proofs of subsidence over a vast area should be offered. The nature of the bottom of the sea immediately surrounding Keeling atoll was carefully examined, and moreover soundings with the wide bell-shaped lead, with tallow armings, were carefully taken, off the fringing reefs of Mauritius. In Keeling atoll outside the reef it was found, "to the depth of ten or twelve fathoms the bottom is exceedingly rugged and seems formed of great masses of living coral, similar to those on the margin. The arming of the lead here invariably came up quite clean, but deeply indented, and chains and anchors which were lowered in the hopes of tearing up the coral were broken." "Between 12 and 20 fathoms the arming came up an equal number of times smoothed with sand and indented with coral; an anchor and lead were lost at the respective depths of 13 and 16 fathoms. Out of twenty-five soundings taken at a greater depth than 20 fathoms, every one showed that the bottom was covered with sand." Off the reef at Mauritius, "from 15 to 20 fathoms, the bottom was with few exceptions either formed of sand or thickly coated with Seriatopora (one of the Tabulata). At 20 fathoms one sounding brought up a fragment of Madrepora which I believe to be the same species as that which mainly forms the upper margin of the reef; if so, it grows in depths varying from 0 to 20 fathoms. Between 20 and 23 fathoms I obtained several soundings, and they all showed a sandy bottom with one exception at 30 fathoms, when the arming came up scooped out as if by the margin of a large Caryophyllia." "The circumstance of the arming having invariably come up quite clean when sounding within a certain number of fathoms off the reef of Mauritius and Keeling atoll (8 fathoms in the former case and 12 in the latter), and of its having always come up (with one exception) smoothed and covered with sand when the depth exceeded 20 fathoms, probably indicate a criterion by which the limiting of the vigorous growth of coral might in all cases be ascertained.'" Darwin admits that this limit might be exceptionally transgressed, but insists upon the importance of the gradual change, as depth progresses, from living clean coral to a smooth sandy bottom, in endeavouring to fix the depth at which the reef-builders can grow.

Even at this period of Darwin's life, the importance of the struggle for existence had been recognised by him, and had influenced his thoughts. He remarks that "we can understand the gradation only as a prolonged struggle against unfavourable conditions." All subsequent investigations by many independent observers have proved the correctness of this bathymetrical limit of the flourishing of reef-builders, and of late years the general characters of the coral which can exist at a greater depth and even on oceanic floors have been shown to differ essentially from those of the forms which live and flourish amidst the rush of the wave and surf. Darwin notices that where the sea is very shallow, as in the Persian Gulf and in parts of the East Indian Archipelago, the reefs lose their fringing character and appear as separate and irregularly scattered patches, often of considerable area. Around the Philippines the bottom of the sea is "entirely coated by irregular masses of coral, which, although often of large size, do not reach the surface and form reefs." There are huge clumps of Porites and many sponges on the floor of the sea off Cuba, but although these corals belong to reef-building genera, still as species they are not those which grow on flourishing reefs. The reef-builders evidently grow with great rapidity, and their struggle against the tide and currents and waves necessitates a constant process of reparation or of growth to replace fractured branches. They flourish in the warm, highly aërated, rushing water, which is full of living things —their proper food. Beyond the reach and influence of these conditions other species and genera exist, which add to the bulk of the coral mass, but which of themselves would never build up a reef, and it is some of these which have been dredged up from considerable depths. The simple corals and the branching forms without a cellular exotheca to hold them together have an enormous bathymetrical range, and can live in water of 76° F. close to the surface,' and also at a depth of more than 1,000 fathoms in a temperature of less than 32°. But the true reef-builder requires a high temperature, and it therefore becomes very important to discover, as has been suggested by Dr. Carpenter, whether the vast sub-zone of cold water which underlies the superficial and heated water has not much to do with this restriction of certain species to definite depths. We must wait for the results of systematic dredging at great depths in the Pacific before this question can be for ever settled, but at present all our knowledge tends to prove that this deep stratum of cold water would prevent reef-builders from living at any considerable depth, and therefore that they never could have risen by growth from the ocean floor itself. Growing, therefore, on submerged rocks, the reef-builders must have their foundation slowly subsiding, if they are to attain a great thickness and to assume the bulk and the characters of atolls. The direct proofs of subsidence advanced by Mr. Darwin were noticed especially in Keeling atoll. "Appearances indicating a slight encroachment of the water on the level are plainer within the lagoon: I noticed in several places, both on its windward and leeward shores, old cocoa-nut trees falling with their roots undermined and the rotten stumps of others on the beach, where the inhabitants assured us the cocoa-nut would not grow. Capt. Fitzroy pointed out to me near the settlement the foundation-posts of a shed, now washed by every tide, but which the inhabitants stated had seven years ago stood above high-water mark." "From these considerations I inferred that probably the atoll had subsided to a small amount: and this inference was strengthened by the circumstance that in 1834, two years before our visit, the island had been shaken by a severe earthquake, and by two slighter ones during the ten previous years." The observations of such authorities as Williams, Kotzebue, and Stutchbury, respecting the encroachment of the sea on, and the destruction of parts or the whole of islands, were noticed by Darwin in his early edition, and comparisons were made, as in the case of Whitsunday Island, between old and new charts, in support of the evidence of subsidence. The existence of submerged or dead reefs is very properly advanced as an indirect proof of subsidence, and the condition of the Great Chagos bank was considered to explain the effects of a rapid subsidence which killed the corals. But the principal and most interesting evidence is afforded by the relative positions of active volcanic vents and barrier reefs and atolls. Darwin noticed the absence of active volcanoes in the presumed areas of subsidence, and their frequent presence in areas of elevation, the exceptions being very few. In acknowledging Dana's suggestive criticism that he had not laid sufficient weight on the mean temperature of the sea in determining the distribution of coral reefs, Darwin very properly urges that some other cause must account for the absence of coral growth in localities where the surface temperature of the sea is sufficient, and he refers especially to the islands which rise up from the abyssal sea in the Atlantic; but he indicates that temperature evidently has much to do with the absence of reefs on the west coast of Tropical America, the cold current reducing the mean temperature of the sea there below 68°.

Although investigations made subsequently to those of Darwin add almost invariably to the proofs of his theory of atoll formation, and it is received as correct by every teacher, still there have been one or two able criticisms of its general applicability. For instance, Semper, in his description of the Pelew Islands, doubted the evidence of subsidence. His opponent, with his usual justice and candour, gives Semper's objections the most careful consideration, and indeed they deserved this treatment. "He (Semper) states that the southern islands consist of coral rock upraised to the height of from 400 to 500 feet; and some of them before their upheaval appear to have existed as atolls. They are now merely fringed by living reefs. The northern islands are volcanic, deeply indented by bays, and are fronted by barrier reefs. To the north there are three true atolls. Prof. Semper doubts whether the whole group has subsided, partly from the fact of the southern islands being formed of upraised coral rock; but there seems to me no improbability in their having originally subsided, then having been upraised (probably at the time when the volcanic rocks to the north were emptied), and again having subsided. The existence of atolls and barrier reefs in close proximity is manifestly not opposed to my views. On the other hand, the presence of reefs fringing the southern islands is opposed to my views, as such reefs generally indicate that the land has either remained stationary or has been upraised. It must, however, be borne in mind that when the land is prolonged beneath the sea in an extremely steep slope, reefs formed there during subsidence will remain closely attached to the shore and will be undistinguishable from fringing reefs. Now, the submarine flanks of most atolls are very steep; and if an atoll after upheaval and before the sea had eaten deeply into the land and had formed a broad flat surface, were again to subside, the reefs which grew to the surface during the subsiding movement would still closely skirt the coast." The appendix, which contains a detailed description of the reefs and islands in the well-known coloured map, is of the greatest value to the physical geographer, and it includes notices of nearly every known coral tract.

After reading and pondering over this long-prized work, there comes the feeling that Mr. Darwin should at some future time enlarge its scope and deal with the distribution of coral species, and trace back in time the reefs of old. Who would not be glad to be taught from the vigorous pen of the man whose theory has lasted more than thirty years, and will last as long as science, what was the condition of the vast Pacific area prior to the age of reefs and atolls? Mountains of different heights are now more or less submerged, and either capped with vast thicknesses of coral, or their tops are girt with barrier and fringing reefs. Take away the sea and the coral growth, and imagine the conditions which prevailed during the slow piling up of these volcanic rocks, their denudation and final overwhelming by the inrush of the ocean incident to the first phase of subsidence. Little is known concerning the age of the raised reefs of the Pacific, and therefore of the duration of the existing state of things; but in the Caribbean there have been reefs in consecutive ages since the early Cretaceous period, and in that area there have been during past ages subsidences and upheavals with contemporaneous volcanic action, following the same laws as those so elaborately described by Darwin as influencing coral growth in the Pacific.

P. M. D.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Long Peruvian Skull

IT was not my intention to have replied to Dr. J. B. Davis's letter on "The Long Peruvian Skull" in NATURE, vol. x. p. 123, as I shall have an opportunity before long of presenting the subject in detail before scientific readers. I find, however, by letters from England that an answer is expected from me. To me, it seemed little more than a reiteration of his disbelief in the existence of such a type; while it leaves unnoticed what I specified as the main point in the discussion.

Dr. Davis demands the production of "half a score of ancient Peruvian dolichocephalic skulls, the appearance of which totally precludes the possibility of interference by art, or other deforming process." Had an anonymous correspondent so stated the issue, I should have supposed that the writer had never seen half a score of Peruvian skulls in his life. The collection presented by Mr. Hutchinson to Prof. Agassiz numbered 368; and out of this Prof. Wyman reports only *eleven* not flattened or distorted. Is Dr. Davis prepared to rule the remaining 357 out of court as of no value in relation to his brachycephalic type? This question of Peruvian long and short heads must be settled in connection with a deforming element affecting both types, or it cannot be settled at all. Hence my specification of the real issue. Keeping this in view, I must beg leave meanwhile to refer, for the sake of brevity, to my statements in NATURE, vol. x. p. 48, in reference to examples previously adduced; while I now point out others easily accessible to Dr. Davis.

The large collection furnished to Prof. Agassiz was obtained, apparently at one time, from a single locality, "Ancona and its neighbourhood." Hence no doubt the uniformity of type. Doubling this number of skulls from the same locality would add nothing to the evidence. It is otherwise with the London Anthropological Institute. Its collection was obtained at different times, partly from the same accessible locality; but also from Santos, Ica, Passamayo, and Cerro del Oro. These include places hundreds of miles apart; and Prof. Busk, after minute study, reports that the evidence of the existence of a dolichocephalic type afforded by the collection, though "not very abundant, *is nevertheless decisive.*"

It is a case precisely analogous to the remarkable dolichocephalic British type recognised by the acute sagacity of the late lamented Dr. Thurnam, in the Uley, Kennet, Littleton Drew, Rodmarten, and other long barrows in Wiltshire, &c., as illustrated in the *Crania Britannica*, for which so great a debt of gratitude is due to Dr. Davis and his gifted colleague. Those dolichocephalic skulls are exceedingly rare; they are found along with brachycephalic skulls; but, as Dr. Thurnam showed, accompanying elements suggestive of the latter as an inferior or servile class. Long ago, in a paper in the *Canadian Journal* of September 1862, I referred to the analogy this presents to the long Peruvian skull mingling in the ancient Inca cemeteries with crania of a markedly diverse type.

No multiplication of specimens of the less rare brachycephalic skull of the British cist or round barrow will invalidate this exceedingly rare but valuable dolichocephalic British type produced by Dr. Thurnam; and the exhibition of a whole ship's cargo of brachycephalic skulls from the accessible coast cemetery of Ancona is equally ineffective in disproof of the rare Peruvian dolichocephalic skull of Titicaca and other ancient burial-grounds.

Dr. Davis refers to an error in one of the woodcuts of my first edition of "Prehistoric Man." To anyone conversant with the difficulties of a Canadian author correcting proof-sheets for the London press, the chances of error, with proofs passing while the woodcut swere in the engraver's hands, and their mere titles or blank spaces in lieu of them, must be obvious enough. Dr. Davis will find the error pointed out in the preface to the second edition.

University College, Toronto, Aug. 6 DANIEL WILSON

Pollen-grains in the Air

I AM very sorry to find that, owing to my absence from home at the time, a question addressed to me by Mr. A. W. Bennett, in NATURE, vol. ix. p. 485, has escaped my notice hitherto and remained unanswered. Mr. Bennett, alluding to my letter on "Microscopic Examination of Air" (NATURE, vol. ix. p. 439), asks on what ground I refer the "triangular pollen" captured on my slide to the birch and hazel. The identification resulted from comparison under the microscope. The pollen-grains which I obtained from catkins of birch and hazel exhibited three conspicuous equidistant prominences (pores) giving each grain a triangular appearance. I cannot now remember if this appearance was equally distinct before and after immersion in glycerine: probably there was a change of shape due to osmosis. I confess that I used the word "triangular" not in its strict geometrical meaning, but in order to mark a feature which distinguished the pollen-grains of birch and hazel from those of poplar. Referring to my notes, I must admit that the shape of the grains which I identified with birch pollen would have been more accurately described as "spherical with three large protuberances." HUBERT AIRY

Blackheath, S.E., Aug. 31

Chrysomela Banksii

I SHOULD be much obliged if you would allow me to ask the following question of Coleopterists in the columns of NATURE:—

Does *Chrysomela Banksii* possess any quality, such as that of exuding an acrid liquid or the like, which would be likely to make it distasteful to spiders or other animals? I have seen it first taken and then rejected unharmed by a Trap-door Spider, and as these spiders feed largely on beetles, I am led to suppose that this particular beetle has some special protection.

J. TRAHERNE MOGGRIDGE

2, Foxton Villas, Richmond, Surrey, Aug. 27

The Aurora Borealis

MAY I ask the readers of NATURE for information on the following points:—

1. Where can I find references to any observations on the polarisation or otherwise of auroral light?
2. Are there any published lists of auroræ arranged with a view to determine the periodicity of its recurrence; or, if not so arranged, sufficiently extended for such an investigation?
3. Has any observer besides Mr. Backhouse noted the relative proportion between eastward and westward movement of auroral rays? HENRY R. PROCTER

North Shields, Aug. 29

ROBERT EDMOND GRANT, M.D., F.R.S.

ON Sunday, August 23, after an illness of about a fortnight, died Dr. R. E. Grant, for many years Professor of Zoology and Comparative Anatomy at University College, London. The family from which Dr. Grant was descended had its head-quarters in the county of Elgin, whence his father removed to Edinburgh, settling as an accountant and a writer to the signet in Argyll Square. He was one of fourteen children, twelve brothers and two sisters, being the seventh son, and the longest surviving of them all. Neither he nor any of his brothers were married; one sister was, but she left no children. He was born in 1793. Between 1803 and 1808 he was a pupil at the High School, Edinburgh, after leaving which he entered the University of that city as a medical student, attending the lectures of Drs. Monro, Hope, Gregory, Duncan, and others. He took his doctor's degree in 1814, for five years after which he devoted his time to travelling on the Continent, visiting Paris, Rome, Florence, as well as Germany, Bohemia, Hungary, and Austria. In 1822 he settled in Edinburgh, and from then till 1828 contributed several zoological papers to different Scotch scientific societies and journals, including one to the Wernerian Natural History Society, in 1827, on the circulation of fluids through the structure of sponges, in which attention was first drawn to the function of the ossicula and pores of those animals, and which led Mr. Fleming to give the generic name *Grantia* to one member of the family.

In June 1827, whilst still in Edinburgh, Dr. Grant was elected Professor of Zoology and Comparative Anatomy in the new University of London, then being formed; his first lecture was not however delivered until October 1828. For the first few years after he settled in London he communicated several papers on zoological subjects to the Scientific Committee of the Zoological Society, some of which, on points in the anatomy of *Sepiola*, *Loligopsis*, and *Beroë*, read in 1833, are to be found in the first volume of their Transactions. From that time Dr. Grant published no papers of importance.

In 1836 Dr. Grant was elected a Fellow of the Royal Society, and in 1837 he was appointed to the triennial Fullerian Professorship of Physiology at the Royal Institution in Albemarle Street.

At his classes, during one session, it is said that Dr. Grant had only two attendants, these being Mr. Hallam, the illustrious historian, and a young boy; it was always a matter of surprise to the other students of the college how he managed to adapt his lectures to the mental capacity of this trying audience.

During the forty-six years that he held his professorship, he never missed a single lecture. It was his determination, if he had lived, to resign his appointment during the present year.

In disposition Dr. Grant was very retiring and seclusive, and a great reader. He travelled much and was an excellent linguist; so fond of languages was he, that only two years ago he attended lectures on Anglo-Saxon in University College. By his will Dr. Grant leaves his extensive library and all his private collection to University College, together with a sum of money to be employed in maintaining and extending the zoological and zootomical department of the library of the college.

CONFERENCE FOR MARITIME METEOROLOGY

A GENERAL wish having of late been expressed that the measures for the prosecution of Maritime Meteorology, proposed at the International Conference at Brussels in 1853, should be reconsidered, now that the experience of more than twenty years of the operation of these measures has enabled meteorologists to form opinions as to their utility, a conference is now being held at the Meteorological Office, 116, Victoria-street, consisting of the following gentlemen:—Austria—R. Müller, K. K. Hydrographic Office, Pola. *Belgium—Van Rysselberghe, Navigation School, Ostend. Bengal—H. F. Blanford, Meteorological Office, Calcutta. China—J. D. Campbell, Secretary Commissioners of Maritime Customs. Denmark—Capt. N. Hoffmeyer, Meteorological Institute, Copenhagen. France—C. Sainte-Claire Deville, Inspector of Meteorological Stations; A. Delamarche, Ministry of Marine, Paris. Germany—W. H. von Freeden, Deutsche Seewarte, Hamburg; G. Neumayer, Hydrographer, Berlin; Capt. Stempel, Imperial Navy; H. A. Meyer, Commissioner for Investigating German Seas, Kiel. Great Britain—(Board of Trade), Capt. Toynbee; R. H. Scott, Director Meteorological Office, Hon. Sec.; *(Admiralty), Rear-Admiral Nolloth; R. J. Mann, M.D., President Meteorological Society. Holland—Buys Ballot, Royal Meteorological Institute, Utrecht, President; Lieut. J. E. Cornelissen, R.N. Italy—Capt. N. Canevaro, R.N. Norway—H. Mohn, Meteorological Institute, Christiana. Portugal—J. C. de Brito Capello, Observatory, Lisbon. Russia—Capt. M. Rikatcheff, I.R.N., Central Physical Observatory, St. Petersburg; *A. Movitz, Observatory, Tiflis. Spain—C. Pujazon, Marine Observatory, San Fernando; Captain Montijo, S.N. *Turkey—Admiral Hobart Pacha. The basis of discussion will be the Report of the Brussels Conference above referred to, with some other heads relating to instructions, instruments, &c. The Conference will be divided into two sub-committees:—1. Instruments; 2. Observations. A Report of the proceedings will be published by the Meteorological Committee. A programme has already appeared in NATURE, vol. x. p. 152.

DEEP-SEA SOUNDINGS IN THE PACIFIC OCEAN

WE take the following extracts on this subject from a report made to the United States Secretary of the Navy by Commander George E. Belknap, dated United States Steamer *Tuscarora*, Hakodadi, Japan, June 26:—

"I left Yokohama on the 8th inst., and at dawn the next morning began the work of sounding homeward on a great circle passing through the island of Tawaga, of the Aleutian group, and towards Puget's Sound. When about 100 miles east by south from Kinghasan or Sendai Bay, on the east coast of Japan, the lead sank to a depth of 3,427 fathoms, showing a descent of 1,594 fathoms in a run of 30 miles. The result seems extraordinary at so short a distance from the land, but the next coast revealed a depth still more astonishing, the sinker carrying the wire down 4,643 fathoms without reaching the bottom.

"On this occasion, when some 500 fathoms of wire had run out, the sinker was suddenly swept under the ship's bottom by the strong undercurrent, and all efforts to get the wire clear and keep it from tending underneath were unavailing, the difficulty being increased by a fresh breeze and a moderately heavy sea. Finally, when 4,643 fathoms of wire had run out, and only 150 fathoms of wire were left on the reel, it broke close to the surface, and about five miles were lost.

"The strain on the reel was very great, and notwithstanding a weight of 130 lb. on the pulley line, it took three men to check and hold the drum, and the wonder was that the wire had not parted sooner. This great strain must have been due to the action of the strong undercurrent upon the sinker, sweeping it with great force from the ship, as since that cast we have sounded repeatedly in depths of more than 4,000 fathoms, and had no trouble in reaching the bottom.

"The position of the cast, as shown by observation was about 45 miles distant from the previous one, the strong current having carried the ship beyond the position where it was intended to sound. . . . .

"I determined to run back inshore and skirt the stream, beginning a new great circle off Point Komoto, in latitude 40° north. I also concluded to increase the weight of the sinker some 20 lb. . . . .

"It will be seen, by an inspection of the track chart of sounding, that the moment the second line diverges from the coast of Niphon and enters the edge of the Japan stream, but yet runs parallel to the island of Yesso, the water begins to deepen rapidly, and at the cast No. 24, or the third cast from the initial point of curve, a depth of 3,493 fathoms is found. Forty and eighty miles further on depths of 3,587 fathoms and 3,307 fathoms are reached; then the ocean bed or trough of the stream drops nearly a statute mile in the run to the next position, where the sinker is not detached until it has descended to the extraordinary depth of 4,340 fathoms.

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* Not present at the meeting on Aug. 31.

"A good specimen of bottom soil was brought up from that great depth, and the Miller's Casella thermometer, No. 18,136, came up a perfect wreck. . . . .

"The next six casts were made in over 4,000 fathoms water, the last two revealing depths of 4,411 fathoms and 4,655 fathoms respectively, and on both occasions the wire was lost. . . . .

"Sometimes the wire comes in much easier than at others, and cast No. 31, made in 4,120 fathoms, occupied only 1h. 47m. 42s.

"The difference must be due to the varying action of the undercurrents upon the rod, specimen cup, and small lead, increasing or diminishing the resistance in hauling in, according to the extent of curve from the perpendicular. . . . .

"The conditions under which all these deep casts were made were eminently favourable. Believing that such deep water would be impracticable for cable purposes, I resolved to run inshore and sound back along the coast of the Kurile Islands to the position of cast No. 22, then to return and skirt those islands and the coast of Kamschatka as far as Cape Chipounsky, then passing over to the Alutian group. . . . .

"If the time on the great circle route for the proposed cable has failed, at least for the present, the results of these soundings will be of interest and value to hydrographic science, as establishing the fact of depths in the sea hardly to be expected, in view of the numerous soundings made by her Majesty's steamship *Challenger* and this ship, over wide expanses of the Atlantic, Pacific, and Indian Oceans, and confirming the existence of a very deep trough under the Japan stream, similar to that cut by the Gulf Stream on our own coast. . . . .

"As we passed by Sturup, of the Kurile group, dense volumes of smoke were seen rising out of a crater on the east end of the island."

PROCEEDINGS OF THE FRENCH ASSOCIATION

On Sunday the 23rd there was an excursion to Boulogne, to visit the steel-pen factory established by the Blanzy Company, and the Laboratory of Zoology, which Prof. Giard of Lille has organised by the seaside. On Monday many members paid a visit to Turcoing and Roubaix, two large manufacturing places in the vicinity of Lille, where the visitors were received with much courtesy; every workshop was eagerly thrown open for inspection.

At a general session held in the evening, M. Ménier, the large chocolate manufacturer who has realised an immense fortune in his trade, delivered a very appropriate lecture on the creation of wealth by science. No one has had so much practical experience on that subject in the society. M. Alglave, formerly a professor in the Academy of Douai, gave an impressive address on coal-mining in Northern France. It was the first time that M. Alglave, who is very popular in Northern France, was allowed to deliver an address since he got into difficulties with the Government. His address created quite a sensation in the city.

On Tuesday there was a general excursion to Anzin coal-mines. A splendid luncheon was given to the visitors by the Anzin Company, in a large storehouse tastefully ornamented for the occasion with national flags and a trophy of all implements used by miners in their underground industry. M. Marsilly, the general director, proposed "The Visitors," in the name of the Council of Administration. M. Wurtz, in return, proposed "The Council and the illustrious President," whom he did not name, but who is no less a person than M. Thiers, at the mention of whose name enthusiastic cheers broke forth, interrupting M. Wurtz for more than five minutes. M. de Marsilly delivered a very long and able address, summarising all that the mining industry owed to science, and giving a few curious figures relating to his Company. It is 137 years old, and was the first French firm to import steam-engines from England. The number of hands is 15,000, and persons depending upon them 60,000. They are now constructing steam-engines, of 500 horse-power, for underground work. The society visited the Haveley pit, one of the forty belonging to the Company, whose concession covers about 100,000 acres, and is said to be worth more than 8,000,000 sterling. On the same evening M. Gaston Tissander delivered an address on aërostation specially considered as to its meteorological uses. The lecture was illustrated by diagrams showing forms of clouds, optical phenomena connected with aërostation, &c.

On Wednesday all the Sections were busy discussing the several communications, and held two sessions. M. Bergeron gave a most interesting address in the Engineering Department, on the boring of the tunnel between France and England. He said, upon authority, that the French Government had sent to Lord Derby a note asking him if he objected to the granting of the exclusive right for a number of years to a private Company. If the English Government does not raise any objection, the bill will be laid before the Versailles Assembly at the end of the present parliamentary holidays. Special provisions will be made for inundating the tunnel in case of war breaking out between the two countries. The holders of the concession can renounce their rights after spending 80,000*l.* in boring a gallery of exploration at least 1,100 ft. under the sea from low-water mark. The works are to begin on the French side as soon as the concession will have been granted. MM. Léon Say, Rothschild, André, &c. are amongst the petitioners.

There was a very sharp discussion in the Anthropological Section on some theological points which had been raised.

In the evening Col. Laussedat delivered a lecture on optical military telegraphy. Almost all the officers of the garrison were present at the lecture, which was practically illustrated by various experiments.

In the morning of Thursday the business of the Sections was transacted as on the previous day, and at one o'clock a general meeting was held in the Hôtel de Ville under the presidency of M. Wurtz. Some modifications of the by-laws and regulations of the society were unanimously adopted, and the committee was instructed to ask from the Government a decree declaring the society of public utility. This is a step necessary, according to the French laws, to give societies the right of holding properties, accepting legacies, and obtaining parliamentary grants.

M. Wurtz had directed a message to the British Association asking them to send a delegation to take part in the Lille meeting. This could not be accomplished, owing to the distance, but it ended in an exchange of telegraphic courtesies between the two societies.

The British Association being our model, it is necessary for us to study its workings, in order to adapt them as far as we can to our French circumstances and scientific peculiarities. Consequently, the committee was instructed not to name the opening day for the 1875 meeting before ascertaining whether it shall not coincide with the opening of the next session of the British Association.

Two cities were in competition for the 1875 meeting—Clermont Ferrand, where the Puy de Dome Observatory will be inaugurated next year; and Nantes. It was generally supposed that Clermont Ferrand would be selected, but Nantes had sent a special delegate with the power of offering the grant of a large sum of money. Clermont Ferrand is poor and has drained its exchequer in helping M. Alluard in his admirable work; consequently Nantes was all but unanimously selected. The president for the Nantes meeting (1875) will be M. d'Eichtal, a gentleman of great fortune and influence, largely connected with the railway interest, and possessed of high scientific qualifications, having been educated at the Polytechnic School. The assembly appointed M. Faye, the astronomer, to be president of the 1876 meeting, but the town where it is to be held has not been decided on. The meeting was brought to a close by a banquet given at the Hôtel de Ville, by the Mayor of the city.

The number of the members of the Association is 800; it is an excess of 200 on the number of the Lyons meeting. The ladies are very few. Madame Thureau de Villeneuve, the wife of the secretary of the Société de Navigation Ardenne, was the only lady who delivered an address. This was in the section of Geography.

The Paris papers have published very short articles on the proceedings of the Association; none have shown so much interest as the *Times*, who sent a special reporter and published long telegrams on the work of the Sections.

Lille, August 29 W. DE FONVIELLE

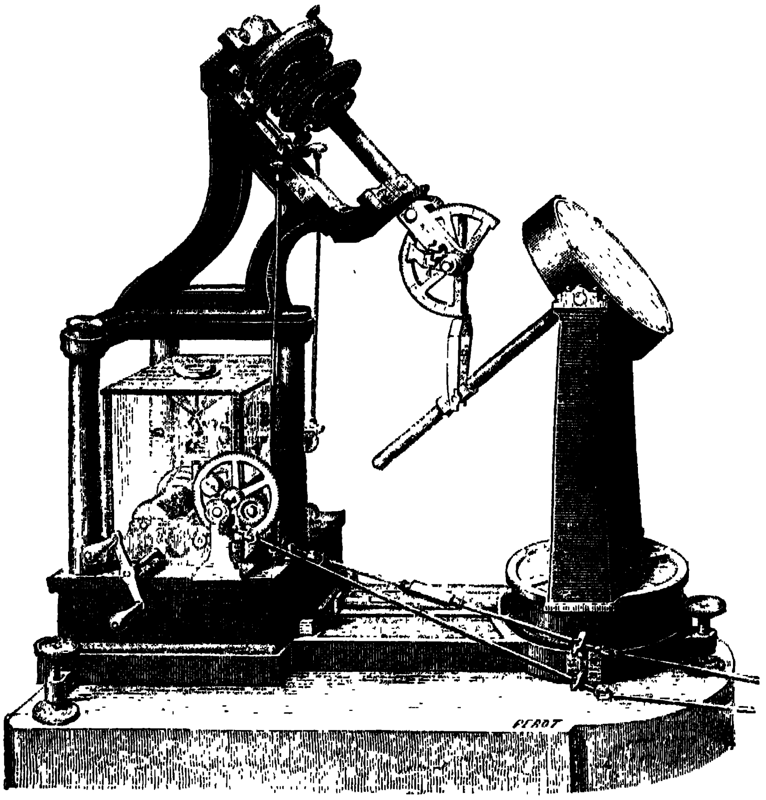

FIG. 1.—The Siderostat.

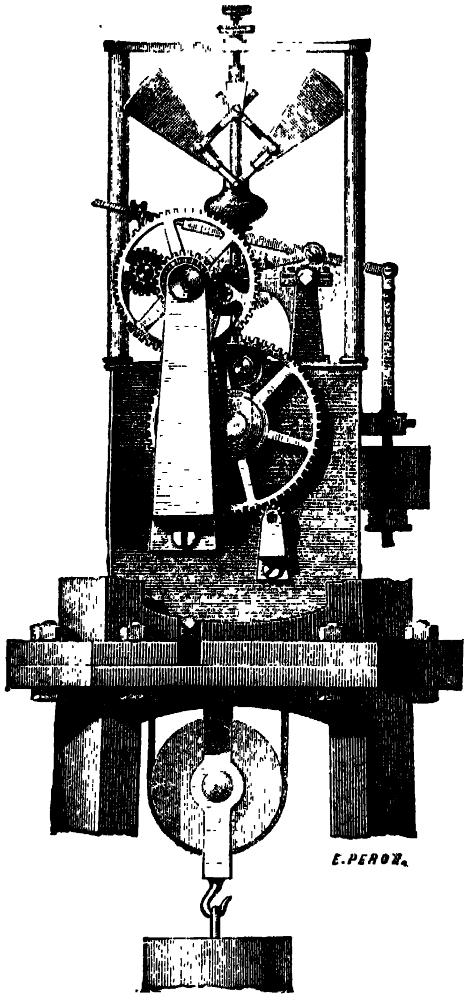

FIG. 2.—Clockwork movement, with isochronous regulator

THE SIDEROSTAT*

THERE is in use at the present moment in the Paris Observatory an instrument of a new construction, which is destined to play a large part in the Astronomy of the future. It is not too much to say that the new instrument will play as important a part in, and will be as essential to the new Astronomy, as the transit instrument plays in the Astronomy of position.

For this instrument in its present form we are indebted to the genius of Foucault, who also gave it its name, the Siderostat.

The use of the present instruments obliges the astronomer to change his position to follow the eye-piece, and consequently to observe frequently in uncomfortable positions. To escape this inconvenience the Germans have long employed the bent telescope, meridian circles and theodolites. But the use of this arrangement is limited to small instruments, while it is precisely in the case of the largest instruments that it would be most useful.

Foucault, who died in the midst of his most important labours, wished in the latter years of his life to give to the equatorial the power of making the entire heavens pass before the observer without his having to disturb himself or to displace the instrument. A telescope fixed horizontally in an invariable position, before which a plane mirror brings successively the various points of the sky—such was the Siderostat in his mind, the idea in all probability having occurred to him from a singular employment of the heliostat by M. Laussedat in observations of the eclipse of 1860. (See Fig. 1.)

The instrument was constructed after the death of its inventor, by M. Eichens, under the direction of the Commission charged with the carrying out and the publication of the works of Foucault, and at the expense of the Imperial treasury. It was presented to the Academy of Sciences on December 13, 1869, then given by Napoleon III. to the Observatory, where it has been installed since 1872.

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* In part translated from an article by M. A. Fraissenet, in *La Nature*. For the woodcuts we are indebted to the kindness of M. Gauthier-Villars.

The instrument, as designed by Foucault, of which M. Wolf has published a complete and detailed account, rests on a brass stand supported by three screws, with two levels placed crossways, and a regulating azimuth movement. There are three distinct parts—the mirror and its mounting, the polar axis and the mechanism which connects this axis with the mirror, and lastly the regulator.

The plane mirror, 30 centimetres in diameter, was constructed by M. Ad. Martin, according to the method devised by Foucault; it is carried by a horizontal axis on the top of two vertical supports, which turn round a centre. This movement is perfectly effected by means of a circle of small wheels placed at the foot of the supports. The mirror is kept in its mounting by means of cleats and spiral springs, in order to avoid all irregularity of surface. In the centre of the mounting is fixed perpendicularly a directing handle, which slides through a ring carried by a fork jointed to the lower extremity of the horary axis. The direction of the incident ray being that of the axis of the fork, and the length of this fork being equal to the distance of its point of articulation from the horizontal axis of the mirror, the line which measures that distance gives the constant direction of the reflected ray.

Finally, a clockwork movement, the isochronous regulator of Foucault (Fig. 2), placed at the foot of the instrument, communicates to the mirror a motion sensibly equal to the diurnal motion, so that the celestial bodies maintain invariable positions in the field of a horizontal telescope, in front of the apparatus directed towards the mirror.

The entire apparatus, the principle of which is the same as that of the heliostat, rests on a triangular support; a hole on the north side receives the weight which drives the clock. A wooden cabin, moving on wheels from north to south, forms a shelter for the instrument. For the purpose of observation the siderostat is completely exposed by rolling the hut towards the north. The telescope, supported on two pillars, is placed in a brick hut, some little distance from the siderostat; this hut is very slightly elevated for the purpose of intercepting the least possible portion of the southern sky. A telescope with a mirror of silvered glass, pierced in the centre to receive the eye-glass, is the one at present employed.

If it is desired to bring into the telescope the light proceeding from a star whose polar distance and right ascension are known, this is done by two circles, which correspond, the one to the polar distance and the other to the horary angle for the moment of observation in the usual way. Then, the circles being fixed, the clockwork is put in motion and the mirror throws continuously into the telescope the rays proceeding from the star under observation. The clock movement, already applied to some great equatorials, is perfectly regular, and obtained for its clever maker, M. Eichens, the grand prize in the mechanical arts at the Universal Exhibition of 1867.

It was necessary to possess, for the siderostat, some means of adjustment so as to be able to vary in very small quantities the horary angle or the polar distance without stopping the movement. The former variation is obtained by means of a subsidiary wheelwork which has already been long in use. But the variation of the polar distance was more difficult to accomplish; M. Eichens, however, has solved the difficulty after a very ingenious fashion.

The siderostat, since its construction, has been almost exclusively employed for photographic experiments in connection with the approaching transit of Venus. Consequently we do not yet know what results we have a right to look for. But in the ideal of Foucault, the instrument ought to be an indispensable auxiliary of physical astronomy; this is its proper purpose. Experiments which demand perfect steadiness will be advantageously made, such as the measure of the positions of spectrum lines and of the displacement of these lines by means of fixed spectroscopes of large dimensions. It is easy to conceive, besides, the numerous advantages resulting from the fixed direction of reflected rays. We may henceforth adapt, with the greatest ease, to the observing telescope, the apparatus necessary for the work of celestial photography for photometric researches.

The complete instrument, telescope and siderostat, placed in the plane of the meridian, may be regarded as a meridian instrument; and the determination of the right ascensions and polar distances of known stars will enable us to rectify the adjustment already made of the relation between the telescope and the siderostat. The purpose is evidently thus not to obtain a transit instrument, but only to get an approximation equal to that of equatorial observations. It is, besides, always in our power to increase the precision by comparing the star under observation with a well-known neighbouring star.

Observations by means of the siderostat may be made in two ways—with the mirror fixed, or turning under the action of the clockwork. In the former case, the instrument becomes to some extent an equatorial, but with the advantage to the observer that he has not to change his position. An inconvenience appears here; each time that the mirror is moved the direction of the apparent movement changes, and consequently it becomes necessary to make a new adjustment of the micrometer threads.

This inconvenience is more serious if, when the mirror is in motion, it is desired to effect measurements of double stars. In this case the direction of the diurnal motion changes the angles of position. It is then necessary to measure the angles of position by starting with the vertical and the horizontal, and, by means of the hour of observation, reducing them to the ordinary form.

The real defect of the siderostat, which, however, it has in common with all other instruments of observation, is that it does not enable us to examine the entire heavens. But the most interesting region for research is comprised between the pole and the southern horizon, and the siderostat which we have described permits observations between these limits. Should it be desired to investigate the rest of the sky, a second siderostat would be necessary, reflecting the rays towards the north.

Let us not, in conclusion, forget that the reflection from the mirror of the instrument causes a slight loss of light; the proportion of light reflected is constant and equal to 93·100 of the incident light for new silver.

From this description it is clear that it is only from the standpoint of physical astronomy that the employment of the instrument will be most useful; and no doubt, in this direction, it will give numerous and important results. The problems of the universe offer, indeed, a productive and inexhaustible mine, and the new astronomy, with its powerful means of investigation, gives us reason to hope that future researches will bring to light some brilliant discoveries.

NOTES

THE *Western Morning News* has received from its correspondent on board the *Challenger* an account of the voyage to New Zealand, which has been stormy and protracted. The result of the soundings has been most satisfactory, and it is confidently expected that New Zealand will be telegraphically connected with Europe next summer. The bottom was sand and mud, gradually shelving to a depth of 2,600 fathoms, at which it remained very evenly for a long distance, the temperature at this depth being 33 degrees and at the surface 64 degrees. At this point the soundings commenced getting less, and the next was found to be 1,975 fathoms (temperature 36 degrees). Two days after this 1,100 fathoms was recorded, the temperature rising to 36 degrees. These indications of shallow water were not without cause, for on the second day they came unexpectedly into 400, 350, and at last only 275 fathoms. This was about 200 miles from land. The future movements of the *Challenger* have now been arranged, and are thus stated:—At Wellington we remain till July 6, then proceed along the east coast, probably calling at Auckland for a few days, after which a course will be shaped to Tongataboo (Friendly Islands), and from thence to Kandsvan (Fiji Islands), where a supply of coal will be taken on board prior to leaving for New Guinea. Here a complete series of explorations and soundings will be made, and it is expected that the dredge and trawl will bring even greater wonders of marine life to the surface than have yet been secured, while the question of coral reefs and their history will have special attention. After cruising about Polynesia generally for some time, we expect to reach Hong Kong early in November, where probably a month will be spent in coaling, provisioning, refitting, &c.

THE last number of Petermann's *Mittheilungen* contains a summary of the recent work done by the *Challenger* Expedition, which is accompanied by an excellent and ingeniously constructed series of coloured diagrams, showing the distribution of temperature in the North and South Atlantic, as well as the configuration of the bottom over which the *Challenger* has sailed. The number also contains the continuation of Prof. Hans Höfer's paper on the structure of Novaya Zemlya.

THE growth of tea and sugar in European soil are perhaps branches of culture which we can scarcely expect to be remunerative in a commercial point of view. Be this as it may, the sugar-cane is now grown and sugar manufactured to some extent in the neighbourhood of Malaga, Spain. Tea has also been introduced into the southern districts of Sicily, and though the first attempt made last year to raise the plants on a large scale was not successful, owing, it is said, to the injury caused to the plants and seeds by immersion in sea-water on their transit from Japan, it is confidently hoped and believed by the promoters that another attempt with healthy seeds and plants will prove quite successful. Meanwhile tea is being grown at the Cinchona plantations in Jamaica, and a sample has recently been received at the Kew Museum which was grown and manufactured as above from Assam tea plants received through Kew in 1868. So far as the appearance of the sample is concerned, it is roughly manipulated, not being sufficiently twisted or curled, and apparently not sufficiently roasted. Nevertheless, its manufacture is little inferior to that of the earliest samples of Assam tea that appeared in the English market. Its quality, however, is another thing, for it produces a very watery infusion of a very herby flavour, and devoid of the aroma for which tea is noted. Care, however, in the cultivation of the plant, as well as in the selection and manipulation of the leaves, may in time produce a more marketable article.

THE Ochro (*Abelmoschus esculentus*), a Malvaceous plant, is well known in all tropical countries, being cultivated for the sake of its fruits, which are gathered in a green state, and either boiled and eaten as a vegetable, pickled in vinegar like capers, or used for thickening soups on account of the mucilage they contain—a common property of the Malvaceæ. In India the seeds are sometimes boiled for making a mucilaginous drink. But we now learn that a fine oil has recently been discovered in them of a quality equal to olive oil, and that it is intended to introduce this oil to commerce. Supposing the oil to be all that is said about it, the question arises as to the supply of seeds. Though the plant is easily cultivated, can it compete with other oleaginous plants?

WE some time since noticed the formation, in connection with the French Geographical Society, of a Commission of Commercial Geography. Under the patronage of this Commission a joint stock company has been formed for the publication of a weekly journal to assist in carrying out the objects aimed at by the Commission. The title of the journal will be *L'Explorateur, Journal Géographique et Commercial.*

EXPERIMENTAL verifications are becoming daily more numerous in favour of the view that the phenomena attending the electrical stimulation of the brain are, in reality, dependent on the indirect excitation of the cerebral basal ganglionic centres by the currents employed. Besides the observations of Dr. Sanderson on this point, already published in this journal (NATURE, vol. x. p. 245), Dr. J. J. Putnam has recorded the results attending electrical stimulation of the so-called surface-centres after their almost complete separation from the rest of the hemisphere in the form of flaps. He finds that under these circumstances no movements follow the excitation; but that if the flap is raised and the surface below it irritated, a current slightly more powerful than the minimal required in the uninjured condition produces exactly similar results. The details of these experiments, taken from the *Boston Medical and Surgical Journal*, will be found in the *London Medical Record* for last week.

THERE has been issued from the Standards Department, by Mr. H. W. Chisholm, an account of the comparisons at that department between two Russian pendulums and Repsold's scale of 21 old French inches, and between Repsold's scale and the standard subdivided imperial yard.

THE French Geological Society has decided upon holding its next meeting at Mons, in Belgium, a most interesting place for excursions. It is very seldom that French Scientific Societies meet in a foreign land.

ON Friday evening M. Flammarion, the French astronomer, started from La Villette gas-works, Paris, in a balloon called *Lumen*, at half-past seven, with a brisk breeze from the north-west. The balloon was under the guidance of M. Jules Godard, and M. Flammarion, who was married in the beginning of August, was on board with his young wife; he wishes to spend his *lune de miel* in Italy. Such a trip was proposed in the beginning of the century to the celebrated Mdme. de Stael by the great philosopher, Saint-Simon; but the lady declined. The moon was full and bright.

THE use of carrier pigeons for press purposes is on the increase, and the breed is rapidly improving. By careful "selection" and allowing only the "survival of the fittest," powers have been developed which a few years ago would have been thought impossible. They can be specially trained to fly over 500 miles, and it is no uncommon thing for despatches to be brought to London from Paris, Lisbon, or Brussels. *Land and Water* records a case of interest. An ocean homing bird, of great docility, intelligence, and spirit, has been found in Iceland which flies at the meteor-like speed of 150 miles an hour. A pair of these birds whose present home is in Kent, within ten miles of London, recently carried despatches from Paris to their home in one hour and a quarter. Press pigeons carried on the despatches to London, and the whole journey of the despatches from Paris to London occupied only one hour and a half. The press pigeons now commonly used are not the ordinary carrier pigeons, but are bred by Messrs. Hartley, of Woolwich, from prize birds selected from the best lofts of Antwerp, Brussels, and Liege.

AN alarming shock of earthquake was felt in the island of Porto Rico on the morning of Aug. 26, at 6.15 A.M. The vibration lasted two minutes. No report of the extent of damage done has yet been received.

AN eruption broke out in Mount Etna on Sunday evening last. The lava issued from the crater by three mouths, all of which, however, are happily some distance from human habitations.

THE *Times of India* states that the report which M. Victor de Lesseps and Mr. C. Stuart will have to make on their return to Europe on the feasibility of the great Central Asian Railway scheme will be of a character to render it likely that preliminary funds will be subscribed to enable the first surveys to be effected with a view to definitely settle the route which it would be desirable to follow.

WE have received from Mr. Stanford the Alpine Club Map of Switzerland, edited by Mr. R. C. Nichols, the preparation of which we noticed in vol. vi. p. 205. It is a very fine specimen of map making, and a credit to English cartography. We hope soon to notice it in detail.

IF the observations recorded by Mr. F. M. Balfour at the recent meeting of the British Association, on the development of the notocord from the hypoblastic, instead of the mesoblastic layer of the embryo in the shark, are confirmed, they will shake to the foundation the importance of the elaborate arguments which have been, of late, so frequently based upon the origin of the different morphological elements of the living frame.

WE are sure many of the recent visitors to Belfast must have found an invaluable aid in their wanderings about the town and district, which so abounds in varied interest, in the very excellent "Guide to Belfast and the Adjacent Counties" (Belfast, Ward and Co.), which has been brought out under the care of the members of the Belfast Naturalists' Field Club. Great prominence is of course given to the scientific aspects of the districts embraced in the Guide, but a fair portion is also devoted to the ordinary objects of interest, to trade, commerce, manufactures, &c. The Guide is well arranged under the various headings of Physical Geography, Geology, Botany, Zoology, Topography, &c., and is amply illustrated with forty-six roughly executed but very useful plates, mostly of objects of antiquarian interest. We heartily recommend the book to any visitor who wants an intelligent guide to the counties of Down and Antrim, a good map of which is appended.

THE additions to the Zoological Society's Gardens during the past week include a Cassowary (*Casuarius?*) from N.E. New Guinea, presented by Capt. Maisby; a Javan Chevrotain (*Tragulus javanicus*) from Java, presented by Mr. G. Mannings; a Formosan Deer (*Cervus pseudaxis*) from the Island of Formosa, presented by Mr. Abel A. J. Gower; two Black Swans (*Cygnus atratus*) from Australia, presented by Mr. R. H. Bower; an Indian Python (*Python molurus*); a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. C. Hassam; two Black-eared Marmosets (*Hapale penicillata*) from Brazil, presented by Mr. J. P. Harrison.

THE BRITISH ASSOCIATION

THE Belfast Session of the British Association was brought to a conclusion on Wednesday, the 26th ult., with mutual congratulations between all concerned. In our animadversions on the high charges for sleeping accommodation charged from some of the members of the Association, we of course meant in no way to reflect on the local authorities or local committee, who exerted themselves to the utmost to render the meeting in every way a success. The vote of thanks to the Mayor was thoroughly deserved, as was also the tribute of praise awarded by the Rev. Dr. Henry to the "unflagging zeal" of Dr. Andrews in behalf of this meeting of the Association. One very pleasing result of the meeting, and of a discussion in the Economical Section, was the sudden termination of the extensive strike which had existed in Belfast for a considerable time. The various excursions organised on Thursday were a decided success.

The next meeting opens at Belfast on August 25, 1875.

The Committee, among other things, have recommended, and their recommendation has been adopted, that the Council of the Association be requested to take such steps as they may think expedient to urge upon the Government of India the desirableness of continuing solar observations; that the Council of the Association be requested to take such steps as they may think desirable with the view of appointing naturalists to vessels engaged on coasts of little-known parts of the world; that they be requested to take such steps as they may think desirable to promote any application that may be made to her Majesty's Government by the Royal Society to promote physiological and biological explorations in the seas round the British Isles; that they be requested to take such steps as they think desirable for supporting a request to her Majesty's Government to undertake an Arctic expedition on the basis proposed by the Council of the Royal Geographical Society at the beginning of the present year, and which will be made again by that body.

The following is a synopsis of grants of money appropriated to scientific purposes by the General Committee at the Belfast Meeting :—

MATHEMATICS AND PHYSICS.	
*Cayley, Prof.—Printing Mathematical Tables ...	£100
*Balfour Stewart, Prof.—Magnetisation of Iron	20
*Brooke, Mr.—British Rainfall	120
*Glaisher, Mr. J.—Luminous Meteors	30
Maxwell, Prof. C.—Testing the Exactness of Ohm's Law	50
Stokes, Prof.—Reflective Power of Silver and other Substances	20
*Herschel, Prof.—Thermal Conducting Powers of Rocks	10
*Tait, Prof.—Thermo-Electricity (renewed)	50
CHEMISTRY.	
*Williamson, Prof. A. W.—Records of the Progress of Chemistry	100
Roscoe, Prof.—Specific Volumes of Liquids	25
Allen, Mr.—Estimation of Potash and Phosphoric Acid	10
*Armstrong, Dr.—Isomeric Cresols and their Derivatives (renewed)	20
GEOLOGY.	
*Willett, Mr. H.—The Sub-Wealden Exploration ..	100
*Lyell, Sir C., Bart.—Kent's Cavern Exploration ...	100
*Lubbock, Sir J.—Exploration of Victoria Cave, Settle...	50
*Bryce, Dr.—Earthquakes in Scotland (renewed) ...	20
Hull, Prof.—Underground Waters in New Red Sandstone and Permian	10
BIOLOGY.	
Dresser, Mr.—Report on Ornithology	10
Rolleston, Prof.—Development of Myxinoid Fishes ...	20
*Stainton, Mr.—Record of the Progress of Zoology ...	100
*Fox, Col. Lane.—Forms of Instruction for Travellers...	20
*Brunton, Dr.—The Nature of Intestinal Secretion ...	20
GEOGRAPHY.	
Wilson, Major.—Palestine Exploration Fund	100
STATISTICS AND ECONOMIC SCIENCE.	
*Houghton, Lord.—Economic Effects of Trades' Unions	25
MECHANICS.	
Froude, Mr.—Instruments for Measuring the Speed of Ships (renewed)	50
Total ...	...£1,180

* Reappointed.

ON THE HYPOTHESIS THAT ANIMALS ARE AUTOMATA, AND ITS HISTORY*

AT this period of the meeting of the British Association I am quite sure it is hardly necessary for me to call to your minds the nature of the business which takes place at our sectional meetings. We there register the progress which science has made during the past year, and we do our best to advance that progress by original communications and free discussion. But when the honourable task of delivering this evening's lecture was imposed upon me, or rather as my friend the President has just said, when I undertook to deliver it, it occurred to me that the occasion of an evening lecture might be turned to a different purpose, that we might with much propriety and advantage turn our minds back to the past to consider what had been done by the great men of old, who "had gone down into the grave with their weapons of war," but who had fought bravely for the cause of truth while they yet lived—to recognise their merits, and to show ourselves duly grateful for their services. I propose, therefore, to take a retrospect of the condition of that branch of science with which it is my business to be more or less familiar—not to a very remote period, for I shall go no further back than the seventeenth century, and the observations which I shall have to offer you will be confined almost entirely to the biological science of the time between the middle of the seventeenth and the middle of the eighteenth centuries. I propose to show what great ideas in biological science took their origin at that time, in what manner the speculations then originated have been developed, and in what relation they stand to what is now understood to be the body of scientific biological truth. The middle of the sixteenth century, or rather the early part of it, is one of the great epochs of biological science. It was at that time that an idea, which had been dimly advocated previously, took the solid form which can only be given to scientific ideas by the definite observation of fact—I mean the idea that vital phenomena, like all other phenomena of the physical world, are capable of mechanical explanation, that they are reducible to law and order, and that the study of biology, in the long run, is an application of the great sciences of physics and chemistry. The man to whom we are indebted for first bringing that idea into a plain and tangible shape, I am proud to say, was an Englishman, William Harvey. Harvey was the first clearly to explain the mechanism of the circulation of the blood, and by that remarkable discovery of his, and by the clearness and precision with which he reduced that process to its mechanical elements, he laid the foundation of a scientific theory of the larger part of the processes of living beings—those processes, in fact, which we now call processes of sustentation—and by his studies of development he, further, first laid the foundation of a scientific knowledge of reproduction. But besides these great powers of living beings, there remains another class of functions—those of the nervous system—with which Harvey did not grapple. It was, indeed, left for a contemporary of his, a man who, as he himself tells us, was mainly stimulated in these inquiries by the brilliant researches of Harvey—René Descartes—to play a part in relation to the phenomena of the nervous system, which, in my judgment, is equal in value to that which Harvey played in regard to the circulation. And when we consider who Descartes was, how brief the span of his life, I think it is a truly wonderful circumstance that this man, who died at fifty-four, should be one of the recognised leaders of philosophy—that, as I am informed by competent authority, he was one of the first and most original mathematicians who has ever lived, and that, at the same time, the fertility of his intellect and the grasp of his genius should have been so great that he could take rank, as I believe he must, beside the immortal Harvey as a physiologist. And you must recollect that Descartes was not merely, as some had been, a happy speculator. He was a working anatomist and physiologist, conversant with all the anatomical and physiological lore of his time, and practised in all methods by which anatomical and physiological discoveries were then made; and it is related of him—and a most characteristic anecdote it is, and one which should ever put to silence those shallow talkers who speak of Descartes as a merely hypothetical and speculative philosopher—that a friend once calling upon him in Holland begged to be shown his library. Descartes led him into a sort of shed, and, drawing aside a curtain, displayed a dissecting-room full of bodies of animals in course of dissection, and said, "There is my library." It would take us a very long time if I were to attempt to pursue the method which would be requisite for the full establishment of all that I am about to say; that is to say, if I were to quote the several passages of Descartess works which bear out my ascription to him of the several propositions which I am going to bring before you. And I must beg you, therefore, to be so good as to take it on my authority for the present, although for the present only, that there are to be found clearly expressed in Descartes' works the propositions which I shall proceed to lay before you, and each of which I shall compare as we go on, as briefly as may be, with the existing state of physiological science, in order that you may see in what position with respect to physiology—ay, even to the advanced physiology of the present time—this man stood. And, happily, the matters with which we shall treat are such as to require no extensive knowledge of anatomy—no more, in fact, than such as, I presume, must be familiar to almost every person.

I think I need only premise that what we call the nervous system in one of the higher animals consists of a central apparatus, composed of the brain, which is lodged in the skull, and of a cord proceeding from it, which is termed the spinal marrow, and which is lodged in the vertebral column or spine, and that from these soft white masses—for such they are—there proceed cords which are termed nerves, some of which nerves end in the muscles, while others end in the organs of sensation. That bare and bald statement of the fundamental composition of the nervous system will be enough for our present purpose.

The first proposition culled from the works of Descartes which I have to lay before you, is one which will sound very familiar. It is the view, which he was the first, so far as I know, to state, not only definitely, but upon sufficient grounds, that the brain is the organ of sensation, of thought, and of emotion—using the word "organ" in this sense, that certain changes which take place in the matter of the brain are the essential antecedents of those states of consciousness which we term sensation, thought, and emotion. Nowadays that is part of popular and familiar knowledge. If your friend disagrees with your opinion, runs amuck against any of your pet prejudices, you say, "Ah! poor fellow, he is a little touched here;" by which you mean that his brain is not doing its business properly, and, therefore, that he is not thinking properly. But in Descartes' time, and I may say for 150 years afterwards, the best physiologists had not reached that point. It remained down to the time of Bichat a question whether the passions were or were not located in the abdominal viscera. This, therefore, was a very great step. It is a statement which Descartes makes from the beginning, and from which he never swerves. In the second place, Descartes lays down the proposition that all the movements of animal bodies are effected by the change of form of a certain part of the matter of their bodies, to which he applies the general term of muscle. You must be aware of this in reading Descartes; you must use the terms in the sense in which he used them, or you will not understand him. That is a proposition which is now placed beyond all doubt whatever. If I move my arm, that movement is due to the change of this mass of flesh in front called the biceps muscle: it is shortened and it becomes thicker. If I move any of my limbs the reason is the same. As I now speak to you, the different tones of my voice are due to the exquisitely accurate adjustment of the contractions of a multitude of such portions of flesh; and there is no considerable and visible movement of the animal body which is not, as Descartes says, resolvable into these changes in the form of matter termed muscle. But Descartes went further, and he stated that in the normal and ordinary condition of things, these changes in the form of muscle in the living body only occur under certain conditions; and the essential condition of the change is, says Descartes, the motion of the matter contained within the nerves, which go from the central apparatus to the muscle. Descartes gave this moving material a particular name—the animal spirits. Nowadays we should not talk of the existence of animal spirits, but we should say that a molecular change takes place in the nerve, and that that molecular change is propagated with a certain velocity, from the central apparatus to the muscle. Nevertheless, the modification of the idea is not greater than that which has taken place in our view of electricity, in our change of conception of it as a fluid to our conception of it as a condition of propagated molecular change. Modern physiology has measured the rate of the change to which I have referred; it has thrown marvellous light upon its nature; it has increased our knowledge of its characters, but the fundamental conception remains exactly what it was in the time of Descartes. Next, Descartes says that, under ordinary circumstances, this change in the contents of a nerve, which gives rise to the contraction of a muscle, is produced by a change in the central nervous apparatus, as, for example, in the brain. We say at the present time exactly the same thing. Descartes said that the animal spirits were stored up in the brain, and flowed out along the motor nerves. We say that a molecular change takes place in the brain that is propagated along the motor nerve. The evidence of that is abundantly supplied by experimental research. Further, Descartes stated that the sensory organs, or those apparatuses which give rise to our feelings when acted upon by the influences which produce sensation, caused a change in the sensory nerves, which he described as a flow of animal spirits along those nerves, which flow was propagated to the brain. If I look at this candle which I hold before me, the light falling on the retina of my eye gives rise to an affection of the optic nerve, which affection Descartes described as a flow of the animal spirits to the brain. We should now speak of it as a molecular change propagated along the optic nerve to the brain; but the fundamental idea is the same. In all our notions of the operations of nerve we are building upon Descartes' foundation. Not only so, but Descartes lays down over and over again, in the most distinct manner, a proposition which is of paramount importance not only for physiology but for psychology. He says that when a body which is competent to produce a sensation touches the sensory organs, what happens is the production of a mode of motion of the sensory nerves. That mode of motion is propagated to the brain. That which takes place in the brain is still nothing but a mode of motion. But, in addition to this mode of motion, there is, as everybody can find by experiment for himself, something else which can in no way be compared to motion, which is utterly unlike it, and which is that state of consciousness which we call a sensation. Descartes insists over and over again upon this total disparity between the agent which excites the state of consciousness and the state of consciousness itself. He tells us that our sensations are not pictures of external things, but that they are symbols or signs of them; and in doing that he made one of the greatest possible revolutions, not only in physiology but in philosophy. Till his time it was conceived that visible bodies, for example, gave from themselves a kind of film which entered the eye and so went to the brain, *species intentionales* as they were called, and thus the mind received an actual copy or picture of things which were given off from it. It is to Descartes we owe that complete revolution in our ideas, which has led us to see that we have really no knowledge whatever of the causes of those phenomena which we term external things, and that the only certainty we possess is that they cannot be like those phenomena. In laying down that proposition upon what I imagine to be a perfectly irrefragable basis, Descartes laid the foundation of that form of philosophy which is termed idealism, which was subsequently expanded to its uttermost by Berkeley, and has since taken very various shapes.

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* Address by Prof. Huxley, F.R.S., at the British Association, Belfast. Aug 24.

But Descartes noticed not only that under certain conditions an impulse made by the sensory organ may give rise to a sensation, but that under certain other conditions it may give rise to motion, and that this motion may be effected without sensation, and not only without volition, but even contrary to it. I trouble you with as little reading as I can, because it occupies so much time; but I must ask your patience for one very remarkable passage which is contained in the answer that Descartes gave to the objections raised by the famous Port Royalist Arnauld to his Fourth Meditation. Descartes says: "It appears to me to be a very remarkable circumstance that no movement can take place either in the bodies of beasts or even in our own, if these bodies have not in themselves all the organs and instruments by means of which the very same movement would be accomplished in a machine, so that, even in us, the spirit or the soul does not directly move the limb, but only determines the course of that very subtle liquid which is called the animal spirits, which, running continually from the heart by the brain into the muscles, is the cause of all the movements of our limbs, and often may cause many different motions, one as easily as the other. And it does not even always exert this determination, for, among the movements which take place in us, there are many which do not depend upon the mind at all, such as the beating of the heart, the digestion of food, the nutrition, the respiration of those who sleep, and, even in those who are awake, walking, singing, and other similar actions when they are performed without the mind thinking about them. And when one who falls from a height throws his hands forward to save his head, it is in virtue of no ratiocination that he performs this action; it does not depend upon his mind, but takes place merely because his senses, being affected by the present danger, cause some change in his brain, which determines the animal spirits to pass thence into the nerves in such a manner as is required to produce this motion, in the same way as in a machine, and without the mind being able to hinder it." I know in no modern treatise of a more clear and precise statement, of a more perfect illustration than this of what we understand by the automatic action of the brain. And what is very remarkable, in speaking of these movements which arise by a sensation being as it were reflected from the central apparatus into a limb—as, for example, when one's finger is pricked and the arm is suddenly drawn up, the motion of the sensory nerve travels to the spine and is again reflected down to the muscles of the arm—Descartes uses the very phrase that we at this present time employ; he speaks of the "*esprits réfléchis*," the reflected spirits; and that this was no mere happy phrase lost upon his contemporaries will be obvious if you consult the famous work of Willis, the Oxford professor, "De Anima Brutorum," which was published about 1672. In giving an account of Descartes' views he borrows this very phrase from him, and speaks of this reflection of the motion of a sensory nerve into the motion of a motor nerve, "sicut undulatione reflexa," as if it were a wave thrown back; so that we have not only the thing reflex action described, but we have the phrase "reflex" recognised in its full significance.

And the last great service to the physiology of the nervous system which I have to mention as rendered by Descartes was this, that he first, so far as I know, sketched out a physical theory of memory. What he tells you in substance is this, that when a sensation takes place, the animal spirits travel up the sensory nerve, pass to the appropriate part of the brain, and there, as it were, find their way through the pores of the substance of the brain. And he says that when this has once taken place, when the particles of the brain have themselves been, as it were, shoved aside a little by a single passage of the animal spirits, the passage is made easier in the same direction for any subsequent flow of animal spirits; and that the repetition of this action makes it easier still, until, at length, it becomes very easy for the animal spirits to move these particular particles of the brain, the motion of which gives rise to the appropriate sensation; and, finally, the passage is so easy that almost any impulse which stirs the animal spirits causes them to flow into these already open pores more easily than they would flow in any other direction; and the flow of the animal spirits recalls the image, the state of consciousness called into existence by a former sensory impression. This view is essentially at one with all our present physical theories of memory. That memory is dependent upon a physical process stands beyond question. The results of the study of disease, the results of the action of poisonous substances, all conclusively point to the fact that memory is inseparably connected with the integrity of certain material parts of the brain and dependent upon them, and I know of no hypothesis by which this fact can be accounted for except by one which is essentially similar to the notion of Descartes, a notion that the impression once made makes subsequent impressions easier and therefore allows almost any indirect disturbance of the brain to call up this particular image.

So far, the ideas started by Descartes have simply been expanded, enlarged, and defined by modern research; they are the keystones of the modern physiology of the nervous system. But in one respect Descartes proceeded further than any of his contemporaries, and has been followed by very few of his successors in later days, although his views were for the best part of a century largely dominant over the intellectual mind of Europe. Descartes reasoned thus: "I can account for many of the actions of living beings mechanically, since reflex actions take place without the intervention of consciousness, and even in opposition to the will." As, for example, when a man in falling mechanically puts out his hand to save himself, or when a person, to use another of Descartes' illustrations, strikes at his friend's eye, and although the friend knows he does not mean to hit him, he nevertheless cannot prevent the muscles of his eye from winking. "In these cases," Descartes said, "I have clear evidence that the nervous system acts mechanically without the intervention of consciousness and without the intervention of the will, or, it may be, in opposition to it. Why, then, may I not extend this idea further? As actions of a certain amount of complexity are brought about in this way, why may not actions of still greater complexity be so produced? Why, in fact, may it not be that the whole of man's physical actions are mechanical, his mind living apart, as it were, and only occasionally interfering by means of volition?" And it so happened that Descartes was led by some of his speculations to believe that beasts had no souls, and consequently could have no consciousness; and thus, his two ideas harmonising together, he developed that famous hypothesis of the automatism of brutes, which is the main subject of my present discourse. What Descartes meant by this was that animals are absolute machines, as if they were mills or barrel organs; that they have no feelings; that a dog does not see, and does not hear, and does not smell, but that the impressions which would produce those states of consciousness in ourselves, give rise in the dog, by a mechanical reflex process, to actions which correspond to those which we perform when we do smell, and do taste, and do see. On the face of it this appears to be a most surprising hypothesis, and I do not wonder that it proved to be a stumbling-block even to such acute and subtle men as Henry More, who was one of Descartes' correspondents; and yet it is a very singular thing that this, the boldest and most paradoxical notion which Descartes broached, has received as much and as strong support from modern physiological research as any other of his hypotheses. I will endeavour to explain to you in as few words as possible what is the nature of that support, and why it is that Descartes' hypothesis, although I am bound to say I do not agree with it, nevertheless, remains at this present time not only quite as defensible as it was in his own time, but I should say, upon the whole, a little more defensible.

If it should happen to a man that by accident his spinal cord is divided, he would become paralysed below the point of injury. In such case his limbs would be absolutely paralysed; he would have no control over them, and they would be devoid of sensation. You might prick his feet, or burn them, or do anything else you like with them, and they would be absolutely insensible. Consciousness, therefore, so far as we can have any knowledge of it, would be entirely abolished in that part of the central nervous apparatus which lies below the injury. But although the man under these circumstances is paralysed in the sense of not being able to move his own limbs, he is not paralysed in the sense of their being deprived of motion, for if you tickle the soles of his feet with a feather the limbs will be drawn up just as vigorously, perhaps a little more vigorously, than when he was in full possession of the consciousness of what happened to him. Now, that is a reflex action. The impression is transmitted from the skin to the spinal cord, it is reflected from the spinal cord, and passes down into the muscles of the limbs, and they are dragged up in this manner—dragged away from the sources of irritation, though the action, you will observe, is a purely automatic or mechanical action. Suppose we deal with a frog in the same way, and cut across the spinal cord. The frog falls into precisely the same condition. So far as the frog is concerned, his limbs are useless; but you have merely to apply the slightest irritation to the skin of the foot, and the limb is instantly drawn away. Now, if we have any ground for argument at all, we have a right to assume that, under these circumstances, the lower half of the frog's body is as devoid of consciousness as is the lower half of the man's body; and that the body of the frog below the injury is in this case absolutely devoid of consciousness, is a mere machine like a musical box or a barrel-organ, or a watch. You will remark, moreover, that the movement of the limbs is purposive—that is to say, that when you irritate the skin of the foot, the foot is drawn away from the danger, just as it would be if the frog were conscious and rational, and could act in accordance with rational consciousness. But you may say it is easy enough to understand how so simple an action might take place mechanically.

Let us consider another experiment. Take this creature, which certainly cannot feel, and touch the skin of the side of the body with a little acetic acid, a little vinegar, which in a frog that could feel would give rise to great pain. In this case there can be no pain, because the application is made below the point of section; nevertheless, the frog lifts up the limb of the same side, and applies the foot to rubbing off the acetic acid; and, what is still more remarkable, if you hold down the limb so that the frog cannot use it, he will, by and by, take the limb of the other side and turn it across the body, and use it for the same rubbing process. It is impossible that the frog, if it were in its entirety and were reasoning, could perform actions more purposive than these, and yet we have most complete assurance that in this case the frog is not acting from purpose, has no consciousness, is a mere automatic machine. But now suppose that instead of making your section of the cord in the middle of the body, you had made it in such a manner as to divide the hindermost part of the brain from the foremost part of the brain, and suppose the foremost two-thirds of the brain entirely taken away, the frog is then absolutely devoid of any spontaneity; it will remain for ever where you leave it; it will not stir unless it is touched; it sits upright in the condition in which a frog habitually does sit; but it differs from the frog which I have just described in this, that if you throw it into the water it begins to swim—swims just as well as the perfect frog does. Now, swimming, you know, requires the combination, and indeed the very careful and delicate combination, of a great number of muscular actions, and the only way we can account for this is, that the impression made upon the sensory nerves of the skin of the frog by the contact of the water, conveys to the central nervous apparatus a stimulus which sets going a certain machinery by which all the muscles of swimming are brought into play in due order and succession. Moreover, if the frog be stimulated, be touched by some irritating body, although we are quite certain it cannot feel, it jumps or walks as well as the complete frog can do. But it cannot do more than this.

Suppose yet one other experiment. Suppose that all that is taken away of the brain is what we call the cerebral hemispheres, the most anterior part of the brain. If that operation is properly performed, the frog may be kept in a state of full bodily vigour for months, or it may be for years; but it will sit for ever in the same spot. It sees nothing; it hears nothing. It will starve sooner than feed itself, although if food is put into its mouth it swallows it. On irritation it jumps or walks; if thrown into the water it swims. But the most remarkable thing that it does is this—you put it in the flat of your hand; it sits there, crouched, perfectly quiet, and would sit there for ever. Then if you incline your hand, doing it very gently and slowly, so that the frog would naturally tend to slip off, you feel the creature's fore-paws getting a little slowly on to the edge of your hand until he can just hold himself there, so that he does not fall; then, if you turn your hand, he mounts up with great care and deliberation, putting one leg in front and then another, until he balances himself with perfect precision upon the edge of your hand; then if you turn your hand over, he goes through the opposite set of operations until he comes to sit in perfect security upon the back of your hand. The doing of all this requires a delicacy of co-ordination, and an adjustment of the muscular apparatus of the body which is only comparable to that of a rope-dancer among ourselves; though in truth a frog is an animal very poorly constructed for rope-dancing, and on the whole we may give him rather more credit than we should to a human dancer. These movements are performed with the utmost steadiness and precision, and you may vary the position of your hand, and the frog, so long as you are reasonably slow in your movements, will work backwards and forwards like a clock. And what is still more wonderful is, that if you put the frog on a table, and put a book between him and the light, and give him a little jog behind, he will jump—take a long jump, very possibly—but he won't jump against the book; he will jump to the right or to the left, but he will get out of the way, showing that although he is absolutely insensible to ordinary impressions of light, there is still a something which passes through the sensory nerve, acts upon the machinery of his nervous system, and causes it to adapt itself to the proper action.

Can we go further than this? I need not say that since those days of commencing anatomical science when criminals were handed over to the doctors, we cannot make experiments on human beings, but sometimes they are made for us, and made in a very remarkable manner. That operation called war is a great series of physiological experiments, and sometimes it happens that these physiological experiments bear very remarkable fruit. I am indebted to my friend General Strachey for bringing to my notice an account of a case which appeared within the last four or five days in the scientific article of the *Journal des Débats*. A French soldier, a sergeant, was wounded at the battle of Bazeilles, one, as you recollect, of the most fiercely contested battles of the late war. The man was shot in the head, in the region of what we call the left parietal bone. The bullet fractured the bone. The sergeant had enough vigour left to send his bayonet through the Prussian who shot him. Then he wandered a few hundred yards out of the village, fell senseless, but, after the action, was picked up and taken to the hospital, where he remained some time. When he came to himself, as usual in such cases of injury, he was paralysed on the opposite side of the body, that is to say, the right arm and the right leg were completely paralysed. That state of things lasted, I think, the better part of two years, but sooner or later he recovered from it, and now he is able to walk about with activity, and only by careful measurement can any difference between the two sides and his body be ascertained. The inquiry, the main results of which I shall give you, has been conducted by exceedingly competent persons, and they report that at present this man lives two lives, a normal life and an abnormal life. In his normal life he is perfectly well, cheerful, does his work as a hospital attendant, and is a respectable, well-conducted man. This normal life lasts for about seven-and-twenty days, or thereabouts, out of every month; but for a day or two in each month he passes suddenly and without any obvious change into his abnormal condition. In this state of abnormal life he is still active, goes about as usual, and is to all appearance just the same man as before, goes to bed and undresses himself, gets up, makes his cigarette and smokes it, and eats and drinks. But he neither sees, nor hears, nor tastes, nor smells, nor is he conscious of anything whatever, and he has only one sense organ in a state of activity, namely, that of touch, which is exceedingly delicate. If you put an obstacle in his way, he knocks against it, feels it and goes to the one side; if you push him in any direction, he goes straight on until something stops him. I have said that he makes his cigarettes, but you may supply him with shavings or of anything else instead of tobacco, and still he will go on making his cigarettes as usual. His actions are purely mechanical. He feeds voraciously, but whether you give him aloes or assafœtida, or the nicest thing possible, it is all the same to him. The man is in a condition absolutely parallel to that of the frog I have just described, and no doubt when he is in this condition the functions of his cerebral hemispheres are, at any rate, largely annihilated. He is very nearly —I don't say wholly, but very nearly—in the condition of an animal in which the cerebral hemispheres are extirpated. And his state is wonderfully interesting to me, for it bears on the phenomena of mesmerism, of which I saw a good deal when I was a young man. In this state he is capable of performing all sorts of actions on mere suggestion. For example, he dropped his cane, and a person near him putting it into his hand, the feeling of the end of the cane evidently produced in him those molecular changes of the brain which, had he possessed consciousness, would have given rise to the idea of his rifle; for he threw himself on his face, began feeling for his cartridges, went through the motions of touching his gun, and shouted out to an imaginary comrade, "Here they are, a score of them; but we will give a good account of them." But the most remarkable fact of all is the modification which this injury has made in the man's moral nature. In his normal life he is an upright and honest man. In his abnormal state he is an inveterate thief. He will steal everything he can lay his hands upon, and if he cannot steal anything else, he will steal his own things and hide them away.

Now, if Descartes had had this fact before him, need I tell you that his theory of animal automatism would have been enormously strengthened? He would have said: "Here is a case of a man performing actions more complicated, and to all appearance more dependent on reason, than any of the ordinary operations of animals, and yet you have positive proof that these actions are purely mechanical. What, then, have you to urge against my doctrine that all animals are mere machines?" In the words of Malebranche, who adopted Descartes' view, "In dogs, cats, and other animals, there is neither intelligence nor spiritual soul as we understand the matter commonly; they eat without pleasure, they cry out without pain, they grow without knowing it, they desire nothing, they know nothing, and if they act with dexterity and in a manner which indicates intelligence, it is because God having made them with the intention of preserving them, He has constructed their bodies in such a manner that they escape organically, without knowing it, everything which could injure them and which they seem to fear." Descartes put forward this hypothesis, and I do not know that it can be positively refuted. We can have no direct observation of consciousness in any creature but ourselves. But I must say for myself—looking at the matter on the ground of analogy—taking into account that great doctrine of continuity which forbids one to suppose that any natural phenomena can come into existence suddenly and without some precedent, gradual modification tending towards it, and taking into account the incontrovertible fact that the lower vertebrated animals possess, in a less developed condition, that part of the brain which we have every reason to believe is the organ of consciousness in ourselves, it seems vastly more probable that the lower animals, although they may not possess that sort of consciousness which we have ourselves, yet have it in a form proportional to the comparative development of the organ of that consciousness, and foreshadow more or less dimly those feelings which we possess ourselves. I think that is the most rational conclusion that can be come to. It has this advantage, though this is a consideration which could not be urged in dealing with questions that are susceptible of demonstration, but which is well worthy of consideration in a case like the present, that it relieves us of the very terrible consequences of making any mistake on this subject. I must confess that, looking at the terrible struggle for existence which is everywhere going on in the animal world, and considering the frightful quantity of pain with which that process must be accompanied, if animals are sensitive, I should be glad if the probabilities were in favour of the view of Descartes. But, on the other hand, considering that if we were to regard animals as mere machines, we might indulge in unnecessary cruelties and in careless treatment of them, I must confess I think it much better to err on the right side, and not to concur with Descartes on this point.

But let me point out to you that although we may come to the conclusion that Descartes was wrong in supposing that animals are insensible machines, it does not in the slighest degree follow that they are not sensitive and conscious automata; in fact, that is the view which is more or less clearly in the minds of every one of us. When we talk of the lower animals being provided with instinct, and not with reason, what we really mean is, that although they are sensitive and although they are conscious, yet they act mechanically, and that their different states of consciousness, their sensations, their thoughts (if they have any), their volitions (if they have any), are the products and consequences of their mechanical arrangements. I must confess that this popular view is to my mind the only one which can be scientifically adopted. We are bound by everything we know of the operations of the nervous system to believe that when a certain molecular change is brought about in the central part of the nervous system, that change, in some way utterly unknown to us, causes that state of consciousness that we term a sensation. It is not to be doubted that those motions which give rise to sensation leave in the brain changes of its substance which answer to what Haller called "*vestigia rerum*," and to what that great thinker, David Hartley, termed "Vibratiuncules." The sensation which has passed away leaves behind molecules of the brain competent to its reproduction—"sensigenous molecules," so to speak—which constitute the physical foundation of memory. Other molecular changes give rise to conditions of pleasure and pain, and to the emotion which in ourselves we call volition. I have no doubt that is the relation between the physical processes of the animal and his mental processes. In this case it follows inevitably that these states of consciousness can have no sort of relation of causation to the motions of the muscles of the body. The volitions of animals will be simply states of emotion which precede their actions. To make clear what I mean, suppose I had a frog placed in my hand, and that I could make it, by turning my hand, perform this balancing movement. If the frog were a philosopher, he might reason thus:—"I feel myself uncomfortable and slipping, and, feeling myself uncomfortable, I put my legs out to save myself. Knowing that I shall tumble if I do not put them further, I put them further still, and my volition brings about all these beautiful adjustments which result in my sitting safely." But if the frog so reasoned, he would be entirely mistaken; for the frog does the thing just as well when he has no reason, no sensation, no possibility of thought of any kind. The only conclusion, then, at which there seems any good ground for arriving is that animals are machines, but that they are conscious machines.

I might with propriety consider what I have now said as the conclusion of the observations which I have to offer concerning animal automatism. So far as I know, the problem which we have hitherto been discussing is an entirely open one. I do not know that there is any reason why any person, whatever his opinions may be, should be prevented, if he be so inclined, from accepting the doctrine which I have just now put before you. So far as we know, animals are conscious automata. That doctrine is perfectly consistent with any view that we may choose to take on the very curious speculation—Whether animals possess souls or not, and if they possess souls, whether those souls are immortal or not. The doctrine to which I have referred is not inconsistent with the perfectly strict and literal adherence to the Scripture text concerning "the beast that perisheth," nor, on the other hand, does it prevent anyone from entertaining the amiable convictions ascribed by Pope to his untutored savage, that when he passed to the realms of the blessed "his faithful dog should bear him company." In fact, all these accessory questions to which I have referred involve problems which cannot be discussed by physical science, inasmuch as they do not lie within the scope of physical science, but come into the province of that great mother of all science, Philosophy. Before any direct answer can be given upon any of these questions we must hear what Philosophy has to say for or against the views that may be held. I need hardly say—especially having detained you so long as I find I have done—that I do not propose to enter into that region of discussion, and I might, properly enough, finish what I have to say upon the subject—especially as I have reached its natural limits—if it were not that an experience, now, I am sorry to say, extending over a good many years, leads me to anticipate that what I have brought before you to-night is not likely to escape the fate which, upon many occasions within my recollection, has attended statements of scientific doctrine and of the conclusions towards which science is tending, which have been made in a spirit intended at any rate to be as calm and as judicial as that in which I have now laid these facts before you. I do not doubt that the fate which has befallen better men will befall me, and that I shall have to bear in patience the reiterated assertion that doctrines such as I have put before you have very evil tendencies. I should not wonder if you were to be told by persons speaking with authority—not, perhaps, with that authority which is based upon knowledge and wisdom, but still with authority—that my intention in bringing this subject before you is to lead you to apply the doctrine I have stated, to man as well as brutes, and it will then certainly be further asserted that the logical tendency of such a doctrine is Fatalism, Materialism, and Atheism. Now, let me ask you to listen to another product of that long experience to which I referred. Logical consequences are very important; but in the course of my experience I have found that they are the scarecrows of fools and the beacons of wise men. Logical consequences can take care of themselves. The only question for any man to ask is—"Is this doctrine true, or is it false?" No other question can possibly be taken into consideration until that one is settled. And, as I have said, the logical consequences of doctrines can only serve as a warning to wise men to ponder well whether the doctrine submitted for their consideration be true or not, and to test it in every possible direction. Undoubtedly I do hold that the view I have taken of the relations between the physical and mental faculties of brutes applies in its fulness and entirety to man; and if it were true that the logical consequences of that belief must land me in all these terrible consequences, I should not hesitate in allowing myself to be so landed. I should conceive that if I refused I should have done the greatest and most abominable violence to everything which is deepest in my moral nature. But now I beg leave to say that, in my conviction, there is no such logical connection as is pretended between the doctrine I accept and the consequences which people profess to draw from it. Some years ago I had occasion, in dealing with the philosophy of Descartes, and some other matters, to state my conviction pretty fully on those subjects, and, although I know from experience how futile it is to endeavour to escape from those nicknames which many people mistake for argument, yet, if those who care to investigate these questions in a spirit of candour and justice will look into those writings of mine, they will see my reasons for not imagining that such conclusions can be drawn from such premises. To those who do not look into these matters with candour and with a desire to know the truth, I have nothing whatever to say, except to warn them on their own behalf what they do; for assuredly if, for preaching such doctrine as I have preached to you to-night, I am cited before the bar of public opinion, I shall not stand there alone. On my one hand I shall have, among theologians, St. Augustine, John Calvin, and a man whose name should be well known to the Presbyterians of Ulster—Jonathan Edwards—unless, indeed, it be the fashion to neglect the study of the great masters of divinity, as many other great studies are neglected nowadays; and I should have upon my other hand, among philosophers, Leibnitz; I should have Père Malebranche, who saw all things in God; I should have David Hartley, the theologian as well as philosopher; I should have Charles Bonnet, the eminent naturalist, and one of the most zealous defenders Christianity has ever had. I think I should have, within easy reach, at any rate, John Locke. Certainly the school of Descartes would be there, if not their master; and I am inclined to think that, in due justice, a citation would have to be served upon Immanuel Kant himself. In such society it may be better to be a prisoner than a judge; but I would ask those who are likely to be influenced by the din and clamour which are raised about these questions, whether they are more likely to be right in assuming that those great men I have mentioned—the fathers of the Church and the fathers of Philosophy—knew what they were about; or that the pigmies who raise the din know better than they did what they meant. It is not necessary for any man to occupy himself with problems of this kind unless he so choose. Life is full enough, filled to the brim, by the performance of its ordinary duties; but let me warn you, let me beg you to believe, that if a man elect to give a judgment upon these great questions; still more, if he assume to himself the responsibility of attaching praise or blame to his fellow-men for the judgments which they may venture to express - then, unless he would commit a sin more grievous than most of the breaches of the Decalogue, he must avoid a lazy reliance upon the information that is gathered by prejudice and filtered through passion. Let him go to those great sources that are open to him as to every one, and to no man more open than to an Englishman; let him go back to the facts of nature, and to the thoughts of those wise men who for generations past have been the interpreters of nature.

THE CARNIVOROUS HABITS OF PLANTS*

I HAVE chosen for the subject of my address to you from the chair in which the Council of the British Association has done me the honour of placing me, the carnivorous habits of some of our brother-organisms—Plants.

Various observers have described with more or less accuracy the habits of such vegetable sportsmen as the Sundew, the Venus's Fly-trap, and the Pitcher-plants, but few have inquired into their motives; and the views of those who have most accurately appreciated these have not met with that general acceptance which they deserved.

Quite recently the subject has acquired a new interest, from the researches of Mr. Darwin into the phenomena which accompany the placing albuminous substances on the leaves of Drosera and Pinguicula, and which, in the opinion of a very eminent physiologist, prove, in the case of Dionæa, that this plant digests exactly the same substances and in exactly the same way that the human stomach does. With these researches Mr. Darwin is still actively engaged, and it has been with the view of rendering him such aid as my position and opportunities at Kew afforded me, that I have, under his instructions, examined some other carnivorous plants.

In the course of my inquiries I have been led to look into the early history of the whole subject, which I find to be so little known and so interesting that I have thought that a sketch of it, up to the date of Mr. Darwin's investigations, might prove acceptable to the members of this Association. In drawing it up, I have been obliged to limit myself to the most important plants; and with regard to such of these as Mr. Darwin has studied, I leave it to him to announce the discoveries which, with his usual frankness, he has communicated to me and to other friends; whilst with regard to those which I have myself studied, Sarracenia and Nepenthes, I shall briefly detail such of my observations and experiments as seem to be the most suggestive.

Dionæa.—About 1768 Ellis, a well-known English naturalist, sent to Linnæus a drawing of a plant, to which he gave the poetical name of Dionæa. "In the year 1765," he writes, "our late worthy friend, Mr. Peter Collinson, sent me a dried specimen of this curious plant, which he had received from Mr. John Bartram, of Philadelphia, botanist to the late King." Ellis flowered the plant in his chambers, having obtained living specimens from America. I will read the account which he gave of it to Linnæus, and which moved the great naturalist to declare that, though he had seen and examined no small number of plants, he had never met with so wonderful a phenomenon:—

"The plant, Ellis says, shows that Nature may have some views towards its nourishment, in forming the upper joint of its leaf like a machine to catch food; upon the middle of this lies the bait for the unhappy insect that becomes its prey. Many minute red glands that cover its surface, and which perhaps discharge sweet liquor, tempts the animal to taste them; and the instant these tender parts are irritated by its feet, the two lobes rise up, grasp it fast, lock the rows of spines together, and squeeze it to death. And further, lest the strong efforts for life in the creature just taken should serve to disengage it, three small erect spines are fixed near the middle of each lobe, among the glands, that effectually put an end to all its struggles. Nor do the lobes ever open again, while the dead animal continues there. But it is nevertheless certain that the plant cannot distinguish an animal from a vegetable or mineral substance; for if we introduce a straw or pin between the lobes, it will grasp it fully as fast as if it was an insect."

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* Address in the Department of Zoology and Botany, British Association, Belfast, August 21, by Dr. Hooker, C.B., D.C.L., Pres. R.S.

This account, which in its way is scarcely less horrible than the descriptions of those mediæval statues which opened to embrace and stab their victims, is substantially correct, but erroneous in some particulars. I prefer to trace out our knowledge of the facts in historical order, because it is extremely important to realise in so doing how much our appreciation of tolerably simple matters may be influenced by the prepossessions that occupy our mind.

We have a striking illustration of this in the statement published by Linnæus a few years afterwards. All the facts which I have detailed to you were in his possession; yet he was evidently unable to bring himself to believe that Nature intended the plant—to use Ellis's words—" to receive some nourishment from the animals it seizes;" and he accordingly declared, that as soon as the insects ceased to struggle, the leaf opened and let them go. He only saw in these wonderful actions an extreme case of sensitiveness in the leaves, which caused them to fold up when irritated, just as the sensitive plant does; and he consequently regarded the capture of the disturbing insect as something merely accidental and of no importance to the plant. He was, however, too sagacious to accept Ellis's sensational account of the *coup de grace* which the insects received from the three stiff hairs in the centre of each lobe of the leaf.

Linnæus's authority overbore criticism, if any were offered; and his statements about the behaviour of the leaves were faithfully copied from book to book.

Broussonet (in 1784) attempted to explain the contraction of the leaves by supposing that the captured insect pricked them, and so let out the fluid which previously kept them turgid and expanded.

Dr. Darwin (1761) was contented to suppose that the Dionæa surrounded itself with insect traps to prevent depredations upon its flowers.

Sixty years after Linnæus wrote, however, an able botanist, the Rev. Dr. Curtis (dead but a few years since) resided at Wilmington, in North Carolina, the head-quarters of this very local plant. In 1834 he published an account of it in the *Boston Journal of Natural History*, which is a model of accurate scientific observation. This is what he said:—"Each half of the leaf is a little concave on the inner side, where are placed three delicate hair-like organs, in such an order that an insect can hardly traverse it without interfering with one of them, when the two sides suddenly collapse and enclose the prey, with a force surpassing an insect's efforts to escape. The fringe of hairs on the opposite sides of a leaf interlace, like the fingers of two hands clasped together. The sensitiveness resides only in these hair-like processes on the inside, as the leaf may be touched or pressed in any other part without sensible effects. The little prisoner is not crushed and suddenly destroyed, as is sometimes supposed, for I have often liberated captive flies and spiders, which sped away as fast as fear or joy could carry them. At other times I have found them enveloped in a fluid of a mucilaginous consistence, which seems to act as a solvent, the insects being more or less consumed in it."

To Ellis belongs the credit of divining the purpose of the capture of insects by the Dionæa. But Curtis made out the details of the mechanism, by ascertaining the seat of the sensitiveness in the leaves; and he also pointed out that the secretion was not a lure exuded before the capture, but a true digestive fluid poured out, like our own gastric juice after the ingestion of food.

For another generation the history of this wonderful plant stood still; but in 1868 an American botanist, Mr. Canby, who is happily still engaged in botanical research—while staying in the Dionæa district, studied the habits of the plant pretty carefully, especially the points which Dr. Curtis had made out. His first idea was that "the leaf had the power of dissolving animal matter, which was then allowed to flow along the somewhat trough-like petiole to the root, thus furnishing the plant with highly nitrogenous food." By feeding the leaves with small pieces of beef, he found, however, that these were completely dissolved and absorbed; the leaf opening again with a dry surface, and ready for another meal, though with an appetite somewhat jaded. He found that cheese disagreed horribly with the leaves, turning them black, and finally killing them. Finally, he details the useless struggles of a Curculio to escape, as thoroughly establishing the fact that the fluid already mentioned is actually secreted, and is not the result of the decomposition of the substance which the leaf has seized. The Curculio being of a resolute nature, attempted to eat his way out,—"when discovered he was still alive, and had made a small hole through the side of the leaf, but was evidently becoming very weak. On opening the leaf, the fluid was found in considerable quantity around him, and was without doubt gradually overcoming him. The leaf being again allowed to close upon him, he soon died."

At the meeting of this Association last year, Dr. Burdon-Sanderson made a communication, which, from its remarkable character, was well worthy of the singular history of this plant; one by no means closed yet, but in which his observations will head a most interesting chapter.

It is a generalisation—now almost a household word—that all living things have a common bond of union in a substance—always present where life manifests itself—which underlies all their details of structure. This is called *protoplasm*. One of its most distinctive properties is its aptitude to contract; and when in any given organism the particles of protoplasm are so arranged that they act as it were in concert, they produce a cumulative effect which is very manifest in its results. Such a manifestation is found in the contraction of muscle; and such a manifestation we possibly have also in the contraction of the leaf of Dionæa.

The contraction of muscle is well known to be accompanied by certain electrical phenomena. When we place a fragment of muscle in connection with a delicate galvanometer, we find that between the outside surface and a cut surface there is a definite current, due to what is called the electromotive force of the muscle. Now, when the muscle is made to contract, this electromotive force momentarily disappears. The needle of the galvanometer, deflected before, swings back towards the point of rest; there is what is called a *negative variation*. All students of the vegetable side of organised nature were astonished to hear from Dr. Sanderson that certain experiments which, at the instigation of Mr. Darwin, he had made, proved to demonstration that when a leaf of Dionæa contracts, the effects produced are precisely similar to those which occur when muscle contracts.

Not merely, then, are the phenomena of digestion in this wonderful plant like those of animals, but the phenomena of contractility agree with those of animals also.

Drosera.—Not confined to a single district in the New World, but distributed over the temperate parts of both hemispheres, in sandy and marshy places, are the curious plants called Sundews—the species of the genus Drosera. They are now known to be near congeners of Dionæa, a fact which was little more than guessed at when the curious habits which I am about to describe were first discovered.

Within a year of each other, two persons—one an Englishman, the other a German—observed that the curious hairs which everyone notices on the leaf of Drosera were sensitive.

This is the account which Mr. Gardom, a Derbyshire botanist, gives of what his friend Mr. Whateley, "an eminent London surgeon," made out in 1780:—"On inspecting some of the contracted leaves we observed a small insect or fly very closely imprisoned therein, which occasioned some astonishment as to how it happened to get into so confined a situation. Afterwards, on Mr. Whateley's centrically pressing with a pin other leaves yet in their natural and expanded form, we observed a remarkably sudden and elastic spring of the leaves, so as to become inverted upwards, and, as it were, encircling the pin, which evidently showed the method by which the fly came into its embarrassing situation."

This must have been an account given from memory, and represents the movement of the hairs as much more rapid than it really is.

In July of the preceding year (though the account was not published till two years afterwards), Roth, in Germany, had remarked in *Drosera rotundifolia* and *longifolia*, "that many leaves were folded together from the point towards the base, and that all the hairs were bent like a bow, but that there was no apparent change on the leaf-stalk." Upon opening these leaves, he says, "I found in each a dead insect; hence I imagined that this plant, which has some resemblance to the *Dionæa muscipula*, might also have a similar moving power."

"With a pair of pliers I placed an ant upon the middle of the leaf of *D. rotundifolia*, but not so as to disturb the plant The ant endeavoured to escape, but was held fast by the clammy juice at the points of the hairs, which was drawn out by its feet into fine threads. In some minutes the short hairs on the disc of the leaf began to bend, then the long hairs, and laid themselves upon the insect. After a while the leaf began to bend, and in some hours the end of the leaf was so bent inwards as to touch the base. The ant died in fifteen minutes, which was before all the hairs had bent themselves."

These facts, established nearly a century ago by the testimony of independent observers, have up to the present time been almost ignored; and Trecul, writing in 1855, boldly asserted that the facts were not true.

More recently, however, they have been repeatedly verified: in Germany by Nilschke, in 1860; in America by a lady, Mrs. Treat, of New Jersey, in 1871; in this country by Mr. Darwin, and also by Mr. A. W. Bennett.

To Mr. Darwin, who for some years past has had the subject under investigation, we are indebted, not merely for the complete confirmation of the facts attested by the earliest observers, but also for some additions to those facts which are extremely important. The whole investigation still awaits publication at his hands, but some of the points which were established have been announced by Professor Asa Gray in America, to whom Mr. Darwin had communicated them.

Mr. Darwin found that the hairs on the leaf of Drosera responded to a piece of muscle or other animal substance, while to any particle of inorganic matter they were nearly indifferent. To minute fragments of carbonate of ammonia they were more responsive.

I will now give the results of Mrs. Treat's experiments, in her own words:—

"Fifteen minutes past ten I placed bits of raw beef on some of the most vigorous leaves of *Drosera longifolia*. Ten minutes past twelve two of the leaves had folded around the beef, hiding it from sight. Half-past eleven on the same day, I placed living flies on the leaves of *D. longifolia*. At twelve o'clock and forty-eight minutes, one of the leaves had folded entirely round its victim, and the other leaves had partially folded, and the flies had ceased to struggle. By half-past two, four leaves had each folded around a fly. The leaf folds from the apex to the petiole, after the manner of its vernation. I tried mineral substances, bits of dried chalk, magnesia, and pebbles. In twenty-four hours neither the leaves nor the bristles had made any move in clasping these articles. I wetted a piece of chalk in water, and in less than an hour the bristles were curving about it, but soon unfolded again, leaving the chalk free on the blade of the leaf."

Time will not allow me to enter into further details with respect to Dionæa and Drosera. The repeated testimony of various observers spreads over a century, and though at no time warmly received, must, I think, satisfy you that in this small family of the Droseraceæ we have plants which in the first place capture animals for purposes of food, and in the second, digest and dissolve them by means of a fluid which is poured out for the purpose; and thirdly, absorb the solution of animal matter which is so produced.

Before the investigations of Mr. Darwin had led other persons to work at the subject, the meaning of these phenomena was very little appreciated. Only a few years ago, Duchartre, a French physiological botanist, after mentioning the views of Ellis and Curtis with respect to Dionæa, expressed his opinion that the idea that its leaves absorbed dissolved animal substances was too evidently in disagreement with our knowledge of the function of leaves and the whole course of vegetable nutrition to deserve being seriously discussed.

Perhaps if the Droseraceæ were an isolated case of a group of plants exhibiting propensities of this kind, there might be some reason for such a criticism. But I think I shall be able to show you that this is by no means the case. We have now reason to believe that there are many instances of these carnivorous habits in different parts of the vegetable kingdom, and among plants which have nothing else in common but this.

As another illustration I shall take the very curious group of Pitcher-plants which is peculiar to the New World. And here also I think we shall find it most convenient to follow the historical order in the facts.

Sarracenia.—The genus Sarracenia consists of eight species, all similar in habit, and all natives of the Eastern States of North America, where they are found more especially in bogs, and even in places covered with shallow water. Their leaves, which give them a character entirely their own, are pitcher-shaped or trumpet-like, and are collected in tufts springing immediately from the ground; and they send up at the flowering season one or more slender stems bearing each a solitary flower. This has a singular aspect, due to a great extent to the umbrella like expansion in which the style terminates; the shape of this, or perhaps of the whole flower, caused the first English settlers to give to the plant the name of Side-saddle Flower.

Sarracenia purpurea is the best known species. About ten years ago it enjoyed an evanescent notoriety from the fact that its rootstock was proposed as a remedy for small-pox. It is found from Newfoundland southward to Florida, and is fairly hardy under open-air cultivation in the British Isles. At the commencement of the seventeenth century, Clusius published a figure of it, from a sketch which found its way to Lisbon and thence to Paris. Thirty years later Johnson copied this in his edition of Gerard's Herbal, hoping "that some or other that travel into foreign parts may find this elegant plant, and know it by this small expression, and bring it home with them, so that we may come to a perfecter knowledge thereof." A few years afterwards this wish was gratified. John Tradescant the younger found the plant in Virginia, and succeeded in bringing it home alive to England. It was also sent to Paris from Quebec by Dr. Sarrazin, whose memory has been commemorated in the name of the genus, by Tournefort.

The first fact which was observed about the pitchers was, that when they grew they contained water. But the next fact which was recorded about them was curiously mythical. Perhaps Morrison, who is responsible for it, had no favourable opportunites of studying them, for he declares them to be, what is by no means really the case, intolerant of cultivation (*respuere culturam videntur*).

He speaks of the lid, which in all the species is tolerably rigidly fixed, as being furnished, by a special act of providence, with a hinge. This idea was adopted by Linnæus, and somewhat amplified by succeeding writers, who declared that in dry weather the lid closed over the mouth, and checked the loss of water by evaporation. Catesby, in his fine work on the Natural History of Carolina, supposed that these water-receptacles might "serve as an asylum or secure retreat for numerous insects, from frogs and other animals which feed on them;"—and others followed Linnæus in regarding the pitchers as reservoirs for birds and other animals, more especially in times of drought; "*præbet aquam sitientibus aviculis.*"

The superficial teleology of the last century was easily satisfied without looking far for explanations, but it is just worth while pausing for a moment to observe that, although Linnæus had no materials for making any real investigation as to the purpose of the pitchers of Sarracenias, he very sagaciously anticipated the modern views as to their affinities. They are now regarded as very near allies of water-lilies—precisely the position which Linnæus assigned to them in his fragmentary attempt at a true natural classification. And besides this, he also suggested the analogy, which, improbable as it may seem at first sight, has been worked out in detail by Baillon (in apparent ignorance of Linnæus' writings) between the leaves of Sarracenia and water-lilies.

Linnæus seems to have supposed that Sarracenia was originally aquatic in its habits, that it had Nymphæa-like leaves, and that when it took to a terrestrial life its leaves became hollowed out, to contain the water in which they could no longer float—in fact, he showed himself to be an evolutionist of the true Darwinian type.

Catesby's suggestion was a very infelicitous one. The insects which visit these plants may find in them a retreat, but it is one from which they never return. Linnæus' correspondent Collinson remarked in one of his letters, that "many poor insects lose their lives by being drowned in these cisterns of water;" but William Bartram, the son of the botanist, seems to have been the first to put on record, at the end of the last century, the fact that Sarracenias catch insects and put them to death in the wholesale way that they do.

Before stopping to consider how this is actually achieved, I will carry the history a little further.

In the two species in which the mouth is unprotected by the lid it could not be doubted that a part, at any rate, of the contained fluid was supplied by rain. But in *Sarracenia variolaris*, in which the lid closes over the mouth, so that rain cannot readily enter it, there is no doubt that a fluid is secreted at the bottom of the pitchers, which probably has a digestive function. William Bartram, in the preface to his travels in 1791, described this fluid, but he was mistaken in supposing that it acted as a lure. There is a sugary secretion which attracts insects, but this is only found at the upper part of the tube. Bartram must be credited with the suggestion, which he, however, only put forward doubtfully, that the insects were dissolved in the fluid, and then became available for the alimentation of the plants.

Sir J. E. Smith, who published a figure and description of *Sarracenia variolaris*, noticed that it secreted fluid, but was content to suppose that it was merely the gaseous products of the decomposition of insects that subserved the processes of vegetation. In 1829, however, thirty years after Bartram's book, Burnett wrote a paper containing a good many original ideas expressed in a somewhat quaint fashion, in which he very strongly insisted on the existence of a true digestive process in the case of Sarracenia, analogous to that which takes place in the stomach of an animal.

Our knowledge of the habits of *Sarracenia variolaris* is now pretty complete, owing to the observations of two South Carolina physicians. One, Dr. M'Bride, made his observations half a century ago, but they had, till quite recently, completely fallen into oblivion. He devoted himself to the task of ascertaining why it was that *Sarracenia variolaris* was visited by flies, and how it was that it captured them. This is what he ascertained :—

"The cause which attracts flies is evidently a viscid substance resembling honey, secreted by or exuding from the internal surface of the tube. From the margin, where it commences, it does not extend lower than one-fourth of an inch. The falling of the insect as soon as it enters the tube is wholly attributable to the downward or inverted position of the hairs of the internal surface of the leaf. At the bottom of a tube split open, the hairs are plainly discernible, pointing downwards; as the eye ranges upward they gradually become shorter and attenuated, till at or just below the surface covered by the bait they are no longer perceptible to the naked eye, nor to the most delicate touch. It is here that the fly cannot take a hold sufficiently strong to support itself, but falls."

Dr. Mellichamp, who is now resident in the district in which Dr. M'Bride made his observations, has added a good many particulars to our knowledge. He first investigated the fluid which is secreted at the bottom of the tubes. He satisfied himself that it was really secreted, and describes it as mucilaginous, but leaving in the mouth a peculiar astringency. He compared the action of this fluid with that of distilled water on pieces of fresh venison, and found that after fifteen hours the fluid had produced most change, and also most smell; he therefore concluded that as the leaves when stuffed with insects become most disgusting in odour, we have to do, not with a true digestion, but with an accelerated decomposition. Although he did not attribute any true digestive power to the fluid secreted by the pitchers, he found that it had a remarkable anæsthetic effect upon flies immersed in it. He remarked that "a fly when thrown into water is very apt to escape, as the fluid seems to *run* from its wings," but it never escaped from the Sarracenia secretion. About half a minute after being thrown in, the fly became to all appearance dead, though, if removed, it gradually recovered in from half an hour to an hour.

According to Dr. Mellichamp, the sugary lure discovered by Dr. M'Bride, at the mouth of the pitchers, is not found on either the young ones of one season or the older ones of the previous year. He found, however, that about May it could be detected without difficulty, and more wonderful still, that there is a honey-baited pathway leading directly from the ground to the mouth, along the broad wing of the pitcher, up which insects are led to their destruction. From these narratives it is evident that there are two very different types of pitcher in Sarracenia, and an examination of the species shows that there may probably be three. These may be primarily classified into those with the mouth open and lid erect, and which consequently receive the rain-water in more or less abundance; and those with the mouth closed by the lid, into which rain can hardly, if at all, find ingress.

To the first of these belongs the well-known *S. purpurea*, with inclined pitchers, and a lid so disposed as to direct all the rain that falls upon it also into the pitcher; also *S. flava, rubra*, and *Drummondii*, all with erect pitchers and vertical lids; of these three, the lid in a young state arches over the mouth, and in an old state stands nearly erect, and has the sides so reflected that the rain which falls on its upper surface is guided down the outside of the back of the pitcher, as if to prevent the flooding of the latter.

To the second group belong *S. psittacina* and *S. variolaris*.

The tissues of the internal surfaces of the pitchers are singularly beautiful. They have been described in one species only, the *S. purpurea*, by August Vogl; but from this all the other species which I have examined differ materially. Beginning from the upper part of the pitcher, there are four surfaces, characterised by different tissues, which I shall name and define as follows :—

1. An *attractive* surface, occupying the inner surface of the lid, which is covered with an epidermis, stomata, and (in common with the mouth of the pitcher) with minute honey-secreting glands; it is further often more highly coloured than any other part of the pitcher, in order to attract insects to the honey.
2. A *conducting* surface, which is opaque, formed of glassy cells, which are produced into deflexed, short, conical, spinous processes. These processes, overlapping like the tiles of a house, form a surface down which an insect slips, and affords no foothold to an insect attempting to crawl up again.
3. A *glandular* surface (seen in *S. purpurea*), which occupies a considerable portion of the cavity of the pitcher below the conducting surface. It is formed of a layer of epidermis with sinuous cells, and is studded with glands; and being smooth and polished, this too affords no foothold for escaping insects.
4. A *detentive* surface, which occupies the lower part of the pitcher, in some cases for nearly its whole length. It possesses no cuticle, and is studded with deflexed, rigid, glass-like, needle-formed, striated hairs, which further converge towards the axis of the diminishing cavity; so that an insect, if once amongst them, is effectually detained, and its struggles have no other result than to wedge it lower and more firmly in the pitcher.

Now, it is a very curious thing that in *S. purpurea*, which has an open pitcher, so formed as to receive and retain a maximum of rain, no honey-secretion has hitherto been found, nor has any water been seen to be secreted in the pitcher; it is, further, the only species in which (as stated above) I have found a special glandular surface, and in which no glands occur on the detentive surface. This concurrence of circumstances suggests the possibility of this plant either having no proper secretion of its own, or only giving it off after the pitcher has been filled with rain-water.

In *S. flava*, which has open-mouthed pitchers and no special glandular surface, I find glands in the upper portion of the detentive surface, among the hairs, but not in the middle or lower part of the same surface. It is proved that *S. flava* secretes fluid, but under what precise conditions I am not aware. I have found none but what may have been accidentally introduced in the few cultivated specimens which I have examined, either in the full-grown state, or in the half-grown when the lid arches over the pitcher. I find the honey in these as described by the American observers, and honey-secreting glands on the edge of the wing of the pitcher, together with similar glands on the outer surface of the pitcher, as seen by Vogl in *S. purpurea*.

Of the pitchers with closed mouths, I have examined those of *S. variolaris* only, whose tissues closely resemble those of *S. flava*. That it secretes a fluid noxious to insects there is no doubt, though in the specimens I examined I found none.

There is thus obviously much still to be learned with regard to Sarracenia, and I hope that American botanists will apply themselves to this task. It is not probable that three pitchers, so differently constructed as those of *S. flava, purpurea*, and *variolaris*, and presenting such differences in their tissues, should act similarly. The fact that insects normally decompose in the fluid of all, would suggest the probability that they all feed on the products of decomposition; but as yet we are absolutely ignorant whether the glands within the pitchers are secretive, or absorptive, or both; if secretive, whether they secrete water or a solvent; and if absorptive, whether they absorb animal matter or the products of decomposition.

It is quite likely, that just as the saccharine exudation only makes its appearance during one particular period in the life of the pitcher, so the digestive functions may also be only of short duration. We should be prepared for this from the case of the Dionæa, the leaves of which cease after a time to be fit for absorption, and become less sensitive. It is quite certain that the insects which go on accumulating in the pitchers of Sarracenias must be far in excess of its needs for any legitimate process of digestion. They decompose; and various insects, too wary to be entrapped themselves, seem habitually to drop their eggs into the open mouth of the pitchers, to take advantage of the accumulation of food. The old pitchers are consequently found to contain living larvæ and maggots, a sufficient proof that the original properties of the fluid which they secreted must have become exhausted; and Barton tells us that various insectivorous birds slit open the pitchers with their beaks to get at the contents. This was probably the origin of Linnæus' statement that the pitchers supplied birds with water.

The pitchers finally decay, and part, at any rate, of their contents must supply some nutriment to the plant by fertilising the ground in which it grows.

Darlingtonia.—I cannot take leave of Sarracenia without a short notice of its near ally, Darlingtonia, a still more wonderful plant, an outlier of Sarracenia in geographical distribution, being found at an elevation of 5,000 ft. on the Sierra Nevada of California, far west of any locality inhabited by Sarracenia. It has pitchers of two forms; one, peculiar to the infant state of the plant, consists of narrow, somewhat twisted, trumpet-shaped tubes, with very oblique open mouths, the dorsal lip of which is drawn out into a long, slender, arching, scarlet hood, that hardly closes the mouth. The slight twist in the tube causes these mouths to point in various directions, and they entrap very small insects only. Before arriving at a state of maturity the plant bears much larger, suberect pitchers, also twisted, with the lip produced into a large inflated hood, that completely arches over a very small entrance to the cavity of the pitcher. A singular orange-red, flabby, two-lobed organ hangs from the end of the hood, right in front of the entrance, which, as I was informed last week by letter from Prof. Asa Gray, is smeared with honey on its inner surface. These pitchers are crammed with large insects, especially moths, which decompose in them, and result in a putrid mass. I have no information of water being found in its pitchers in its native country, but have myself found a slight acid secretion in the young states of both forms of pitcher.

The tissues of the inner surfaces of the pitchers of both the young and the old plant I find to be very similar to those of *Sarracenia variolaris* and *flava*.

Looking at a flowering specimen of Darlingtonia, I was struck with a remarkable analogy between the arrangement and colouring of the parts of the leaf and of the flower. The petals are of the same colour as the flap of the pitcher, and between each pair of petals is a hole (formed by a notch in the opposed margins of each) leading to the stamens and stigma. Turning to the pitcher, the relation of its flap to its entrance is somewhat similar. Now, we know that coloured petals are specially attractive organs, and that the object of their colour is to bring insects to feed on the pollen or nectar, and in this case by means of the hole to fertilise the flower; and that the object of the flap and its sugar is also to attract insects, but with a very different result, cannot be doubted. It is hence conceivable that this marvellous plant lures insects to its flowers for one object, and feeds them while it uses them to fertilise itself, and that, this accomplished, some of its benefactors are thereafter lured to its pitchers for the sake of feeding itself!

But to return from mere conjecture to scientific earnest, I cannot dismiss Darlingtonia without pointing out to you what appears to me a most curious point in its history; which is, that the change from the slender, tubular, open mouthed to the inflated closed-mouthed pitchers is, in all the specimens which I have examined, absolutely sudden in the individual plant. I find no pitchers in an intermediate stage of development. This, a matter of no little significance in itself, derives additional interest from the fact that the young pitchers to a certain degree represent those of the Sarracenias with open mouths and erect lids; and the old pitchers those of the Sarracenias with closed mouths and globose lids. The combination of representative characters in an outlying species of a small order cannot but be regarded as a marvellously significant fact in the view of those morphologists who hold the doctrine of evolution.

Nepenthes.—The genus Nepenthes consists of upwards of thirty species of climbing, half shrubby plants, natives of the hotter parts of the Asiatic Archipelago from Borneo to Ceylon, with a few outlying species in New Caledonia, in Tropical Australia, and in the Seychelle Islands on the African coast. Its pitchers are abundantly produced, especially during the younger state of the plants. They present very considerable modifications of form and external structure, and vary greatly in size, from little more than an inch to almost a foot in length; one species, indeed, which I have here from the mountains of Borneo, has pitchers which, including the lid, measure a foot and a half, and its capacious bowl is large enough to drown a small animal or bird.

The structure of the pitcher of Nepenthes is less complicated on the whole than that of Sarracenia, though some of its tissues are much more highly specialised. The pitcher itself is here not a transformed leaf, as in Sarracenia, nor is it a transformed leaf-blade, like that of Dionæa, but an appendage of the leaf developed at its tip, and answers to a water-secreting gland that may be seen terminating the mid-rib of the leaf of certain plants. It is furnished with a stalk, often a very long one, which in the case of pitchers formed on leaves high up the stem has (before the full development of the pitcher) the power of twisting like a tendril round neighbouring objects, and thus aiding the plant in climbing, often to a great height in the forest.

In most species the pitchers are of two forms, one appertaining to the young, the other to the old state of the plant, the transition from one form to the other being gradual. Those of the young state are shorter and more inflated; they have broad fringed longitudinal wings on the outside, which are probably guides to lead insects to the mouth; the lid is smaller and more open, and the whole interior surface is covered with secreting glands. Being formed near the root of the plant, these pitchers often rest on the ground, and in species which do not form leaves near the root they are sometimes suspended from stalks which may be fully a yard long, and which bring them to the ground. In the older state of the plant the pitchers are usually much longer, narrower, and less inflated, and are trumpet-shaped, or even conical; the wings also are narrower, less fringed, or almost absent. The lid is larger and slants over the mouth, and only the lower part of the pitcher is covered with secreting glands, the upper part presenting a tissue analogous to the conducting tissue of Sarracenia, but very different anatomically. The difference in structure of these two forms of pitcher, if considered in reference to their different positions on the plant, forces the conclusion on the mind that the one form is intended for ground game, the other for winged game. In all cases the mouth of the pitcher is furnished with a thickened corrugated rim, which serves three purposes: it strengthens the mouth and keeps it distended; it secretes honey (at least in all the species I have examined under cultivation, for I do not find that any other observer has noticed the secretion of honey by Nepenthes), and it is in various species developed into a funnel-shaped tube that descends into the pitcher and prevents the escape of insects, or into a row of incurved hooks that are in some cases strong enough to retain a small bird, should it, when in search of water or insects, thrust its body beyond a certain length into the pitcher.

In the interior of the pitcher of Nepenthes there are three principal surfaces: an *attractive*, *conductive*, and a *secretive* surface; the *detentive* surface of Sarracenia being represented by the fluid secretion, which is here invariably present at all stages of growth of the pitcher.

The attractive surfaces of Nepenthes are two: those, namely, of the rim of the pitcher, and of the under surface of the lid, which is provided in almost every species with honey-secreting glands, often in great abundance. These glands consist of spherical masses of cells, each embedded in a cavity of the tissue of the lid, and encircled by a guard-ring of glass-like cellular tissue. As in Sarracenia, the lid and mouth of the pitcher are more highly coloured than any other part, with the view of attracting insects to their honey. It is a singular fact that the only species known to me that wants these honey-glands on the lid is the *N. ampullaria*, whose lid, unlike that of the other species, is thrown back horizontally. The secretion of honey on a lid so placed would tend to lure insects away from the pitcher instead of into it.

From the mouth to a variable distance down the pitcher is an opaque glaucous surface, precisely resembling in colour and appearance the conductive surface of the Sarracenia, and, like it, affording no foothold to insects, but otherwise wholly different; it is formed of a fine network of cells, covered with a glass-like cuticle, and studded with minute reniform transverse excrescences.

The rest of the pitcher is entirely occupied with the secretive surface, which consist of a cellular floor crowded with spherical glands in inconceivable numbers. Each gland precisely resembles a honey-gland of the lid, and is contained in a pocket of the same nature, but semicircular, with the mouth downwards, so that the secretive fluid all falls to the bottom of the pitcher. In the *Nepenthes Rafflesiana* 3,000 of the glands occur on a square inch of the inner surface of the pitcher, and upwards of 1,000,000 in an ordinary sized pitcher. I have ascertained that, as was indeed to be expected, they secrete the fluid which is contained in the bottom of the pitcher before this opens, and that the fluid is always acid.

The fluid, though invariably present, occupies a comparatively small portion of the glandular surface of the pitcher, and is collected before the lid opens. When the fluid is emptied out of a fully formed pitcher that has not received animal matter, it forms again, but in comparatively very small quantities; and the formation goes on for many days, and to some extent even after the pitcher has been removed from the plant. I do not find that placing inorganic substances in the fluid causes an increased secretion, but I have twice observed a considerable increase of fluid in pitchers after putting animal matter in the fluid.

To test the digestive powers of Nepenthes I have closely followed Mr. Darwin's treatment of Dionæa and Drosera, employing white of egg, raw meat, fibrine, and cartilage. In all cases the action is most evident, in some surprising. After twenty-four hours' immersion the edges of the cubes of white of egg are eaten away and the surfaces gelatinised. Fragments of meat are rapidly reduced; and pieces of fibrine weighing several grains dissolve and totally disappear in two or three days. With cartilage the action is most remarkable of all; lumps of this weighing 8 or 10 grains are half gelatinised in twenty-four hours, and in three days the whole mass is greatly diminished, and reduced to a clear transparent jelly. After drying some cartilage in the open air for a week, and placing it in an unopened but fully formed pitcher of *N. Rafflesiana*, it was acted upon similarly and very little slower.

That this process, which is comparable to digestion, is not wholly due to the fluid first secreted by the glands, appears to me most probable; for I find that very little action takes place in any of the substances placed in the fluid drawn from pitchers, and put in glass tubes; nor has any followed after six days' immersion of cartilage or fibrine in pitchers of *N. ampullaria* placed in a cold room; whilst on transferring the cartilage from the pitcher of *N. ampullaria* in the cold room to one of *Rafflesiana* in the stove, it was immediately acted upon. Comparing the action of fibrine, meat, and cartilage placed in tubes of Nepenthes fluid, with others in tubes of distilled water, I observed that their disintegration is three times more rapid in the fluid; but this disintegration is wholly different from that effected by immersion in the fluid of the pitcher of a living plant.

In the case of small portions of meat, ½ to 2 grains, all seem to be absorbed; but with 8 to 10 grains of cartilage it is not so - a certain portion disappears, the rest remains as a transparent jelly, and finally becomes putrid, but not till after many days. Insects appear to be acted upon somewhat differently, for after several days' immersion of a large piece of cartilage I found that a good-sized cockroach, which had followed the cartilage and was drowned for his temerity, in two days became putrid. In removing the cockroach the cartilage remained inodorous for many days. In this case no doubt the antiseptic fluid had permeated the tissue of the cartilage, whilst enough did not remain to penetrate the chitinous hard covering of the insect, which consequently decomposed.

In the case of cartilage placed in fluid taken from the pitcher —it becomes putrid, but not so soon as if placed in distilled water.

From the above observations it would appear probable that a substance acting as pepsine is given off from the inner wall of the pitcher, but chiefly after placing animal matter in the acid fluid; but whether this active agent flows from the glands or from the cellular tissue in which they are imbedded, I have no evidence to show.

I have here not alluded to the action of these animal matters in the cells of the glands, which is, as has been observed by Mr. Darwin in Drosera, to bring about remarkable changes in their protoplasm, ending in their discoloration. Not only is there aggregation of the protoplasm in the gland-cells, but the walls of the cells themselves become discoloured, and the glandular surface of the pitcher that at first was of a uniform green, becomes covered with innumerable brown specks (which are the discoloured glands). After the function of the glands is exhausted, the fluid evaporates, and the pitcher slowly withers.

At this stage I am obliged to leave this interesting investigation. That Nepenthes possesses a true digestive process such as has been proved in the case of Drosera, Dionæa, and Pinguicula, cannot be doubted. This process, however, takes place in a fluid which deprives us of the power of following it further by direct observation. We cannot here witness the pouring out of the digestive fluid; we must assume its presence and nature from the behaviour of the animal matter placed in the fluid in the pitcher. From certain characters of the cellular tissues of the interior walls of the pitcher, I am disposed to think that it takes little part in the processes of either digestion or assimilation, and that these, as well as the pouring out of the acid fluid, are all functions of the glands.

In what I have said I have described the most striking instances of plants which seem to invert the order of nature, and to draw their nutriment—in part, at least—from the animal kingdom, which it is often held to be the function of the vegetable kingdom to sustain.

I might have added some additional cases to those I have already dwelt upon. Probably, too, there are others still unknown to science, or whose habits have not yet been detected. Delpino, for example, has suggested that a plant, first described by myself in the Botany of the Antarctic Voyage, *Caltha dionæafolia*, is so analogous in the structure of its leaves to Dionæa, that it is difficult to resist the conviction that its structure also is adapted for the capture of small insects.

But the problem that forces itself upon our attention is, How does it come to pass that these singular aberrations from the otherwise uniform order of vegetable nutrition make their appearance in remote parts of the vegetable kingdom? why are they not more frequent, and how were such extraordinary habits brought about or contracted? At first sight the perplexity is not diminished by considering—as we may do for a moment—the nature of ordinary vegetable nutrition. Vegetation, as we see it everywhere, is distinguished by its green colour, which we know depends on a peculiar substance called chlorophyll, a substance which has the singular property of attracting to itself the carbonic acid gas which is present in minute quantities in the atmosphere, of partly decomposing it, so far as to set free a portion of its oxygen, and of recombining it with the elements of water, to form those substances, such as starch, cellulose, and sugar, out of which the framework of the plant is constructed.

But, besides these processes, the roots take up certain matters from the soil. Nitrogen forms nearly four-fifths of the air we breathe, yet plants can possess themselves of none of it in the free uncombined state. They withdraw nitrates and salts of ammonia in minute quantities from the ground, and from these they build up with starch, or some analogous material, albuminoids or protein compounds, necessary for the sustentation and growth of protoplasm.

At first sight nothing can be more unlike this than a Dionæa or a Nepenthes capturing insects, pouring out a digestive fluid upon them, and absorbing the albuminoids of the animal, in a form probably directly capable of appropriation for their own nutrition. Yet there is something not altogether wanting in analogy in the case of the most regularly constituted plants. The seed of the castor-oil plant contains, besides the embryo seedling, a mass of cellular tissue or endosperm filled with highly nutritive substances. The seedling lies between masses of this, and is in contact with it; and as the warmth and moisture of germination set up changes which bring about the liquefaction of the contents of the endosperm and the embryo absorbs them, it grows in so doing, and at last, having taken up all it can from the exhausted endosperm, develops chlorophyll in its cotyledons under the influence of light, and relies on its own resources.

A large number of plants, then, in their young condition, borrow their nutritive compounds ready prepared; and this is in effect what carnivorous plants do later in life.

That this is not a merely fanciful way of regarding the relation of the embryo to the endosperm, is proved by the ingenious experiments of Van Tieghem, who has succeeded in substituting for the real, an artificial endosperm, consisting of appropriate nutritive matters. Except that the embryo has its food given to it in a manner which needs no digestion—a proper concession to its infantine state—the analogy here with the mature plants which feed on organic food seems to be complete.

But we are beginning also to recognise the fact that there are a large number of flowering plants that pass through their lives without ever doing a stroke of the work that green plants do. These have been called Saprophytes. Monotropra, the curious bird's nest orchis (*Neottia nidus-avis*), Epipogium, and Corallorhiza are instances of British plants which nourish themselves by absorbing the partially decomposed materials of other plants, in the shady or marshy places which they inhabit. They reconstitute these products of organic decomposition, and build them up once more into an organism. It is curious to notice, however, that the tissues of Neottia still contain chlorophyll in a nascent though useless state, and that if a plant of it be immersed in boiling water, the characteristic green colour reveals itself.

Epipogium and Corallorhiza have lost their proper absorbent organs; they are destitute of roots, and take in their food by the surfaces of their underground stem structures.

The absolute difference between plants which absorb and nourish themselves by the products of the decomposition of plant-structures, and those which make a similar use of animal structures, is not very great. We may imagine that plants accidentally permitted the accumulation of insects in some parts of their structure, and the practice became developed because it was found to be useful. It was long ago suggested that the receptacle formed by the connate leaves of Dipsacus might be an incipient organ of this kind; and though no insectivorous habit has ever been brought home to that plant, the theory is not improbable.

Linnæus, and more lately Baillon, have shown how a pitcher of Sarracenia may be regarded as a modification of a leaf of the Nymphæa type. We may imagine such a leaf first becoming hollow, and allowing *débris* of different kinds to accumulate; these would decompose, and a solution would be produced, some of the constituents of which would diffuse themselves into the subjacent plant tissues. This is in point of fact absorption, and we may suppose that in the first instance—as perhaps still in *Sarracenia purpurea*—the matter absorbed was merely the saline nutritive products of decomposition, such as ammoniacal salts. The act of digestion—that process by which soluble food is reduced without decomposition to a soluble form fitted for absorption—was doubtless subsequently acquired.

The secretion, however, of fluids by plants is not an unusual phenomenon. In many Aroids a small gland at the apex of the leaves secretes fluid, often in considerable quantities, and the pitcher of Nepenthes is, as I have shown elsewhere, only a gland of this kind, enormously developed. May not, therefore, the wonderful pitchers and carnivorous habit of Nepenthes have both originated by natural selection out of one such honey-secreting gland as we still find developed near that part of the pitcher which represents the tip of the leaf? We may suppose insects to have been entangled in the viscid secretion of such a gland, and to have perished there, being acted upon by those acid secretions that abound in these and most other plants. The subsequent differentiation of the secreting organs of the pitcher into aqueous, saccharine, and acid, would follow *pari passu* with the evolution of the pitcher itself, according to those mysterious laws which result in the correlation of organs and functions throughout the kingdom of Nature; and which, in my apprehension, transcend in wonder and interest those of evolution and the origin of species.

Delpino has recorded the fact that the spathe of Alocasia secretes an acid fluid which destroys the slugs that visit it, and which he believes subserves its fertilisation. Here any process of nutrition can only be purely secondary. But the fluids of plants are in the great majority of cases acid, and, when exuded, would be almost certain to bring about some solution in substances with which they came in contact. Thus the acid secretions of roots were found by Sachs to corrode polished marble surfaces with which they came in contact, and thus to favour the absorption of mineral matter.

The solution of albuminoid substances requires, however, besides a suitable acid, the presence of some other albuminoid substance analogous to pepsine. Such substances, however, are frequent in plants. Besides the well-known diastase, which converts the starch of malt into sugar, there are other instances in the synaptase which determines the formation of hydrocyanic acid from emulsine, and the myrosin which similarly induces the formation of oil of mustard. We need not wonder, then, if the fluid secreted by a plant should prove to possess the ingredients necessary for the digestion of insoluble animal matters.

These remarks will, I hope, lead you to see, that though the processes of plant nutrition are in general extremely different from those of animal nutrition, and involve very simple compounds, yet that the protoplasm of plants is not absolutely prohibited from availing itself of food, such as that by which the protoplasm of animals is nourished; under which point of view these phenomena of carnivorous plants will find their place, as one more link in the continuity of nature.

BRITISH ASSOCIATION REPORTS

Report of the Committee on Mathematical Tables.

The objects for which the Committee were appointed at Edinburgh were twofold, viz., the preparation of a list of tables scattered about in books and mathematical journals and transactions, and the calculation of new tables. With regard to the first object, the tables were roughly divided into three classes, viz. (1) ordinary tables (such as trigonometrical and logarithmic) usually published in books; (2) tables of continuously varying quantities, generally definite integrals; and (3) theory of number of tables. On the first class Mr. J. W. L. Glaisher had already written a report, to which it was intended, after the lapse of several years, to add a supplement; with the second some progress had been made; while Prof. Cayley proposed to undertake the third. The Committee had to acknowledge the assistance of several foreigners, and chiefly of Prof. Bierens de Haan, who had forwarded to them an account of 128 logarithmic and 105 non-logarithmic tables; to Dr. Carl Ohrtmann, of Berlin; and Profs. W. W. Johnson and J. M. Rice, of Annapolis, Maryland. The principal achievement, however, which the Committee had to report related to the second object, and was the completion of the tables of the Elliptic Functions, the commencement of which was noticed in NATURE nearly two years ago, and on which six or seven computers, under the superintendence of Mr. J. Glaisher, F.R.S., and Mr. J. W. L. Glaisher, have since been constantly engaged. These tables (which are of double entry) give the four theta functions, which form the numerators and denominators of the three elliptic functions, and their logarithms for 8,100 arguments; so that they contain nearly 65,000 tabular results. The calculation has been carried to ten figures, but only eight will be printed, the tabular portion of the work occupying 360 pages. Parts of the introduction will be written by Prof. Cayley, Sir William Thomson, and Prof. H. J. S. Smith, and it is hoped that before the next meeting of the Association the whole work, which will form one of the largest tables that have appeared as the result of an original calculation, will be in print. It is perhaps desirable to state that the elliptic functions which have thus been tabulated are, as it were, generalised sines and cosines. Sines and cosines may be combined so as to represent any singly periodic function, as is well known; and in the same way elliptic functions represent every possible doubly periodic function; and no quantities can be of a higher degree of periodicity. The elliptic functions (which are in a sense inverse to Legendre's Elliptic Integrals) are thus quantities of the highest importance and generality in mathematics, and they are daily becoming of more importance in physics. They appear conspicuously in the investigation of the motion of a rigid body and in electrostatics, and have also numerous applications in the theory of numbers. The calculations were just completed before the meeting, and the printing will commence immediately: it is intended that the tables shall be stereotyped to ensure freedom from typographical errors.

Report of the Committee on the Nomenclature of Dynamical and Electrical Units.

They have circulated numerous copies of their last year's report among scientific men both at home and abroad. They believe, however, that in order to render their recommendations fully available for science teaching and scientific work, a full and popular exposition of the whole subject of physical units is necessary, together with a collection of examples (tabular and otherwise) illustrating the application of systematic units to a variety of physical measurements. Students usually find peculiar difficulty in questions relating to units; and even the experienced scientific calculator is glad to have before him concrete examples with which to compare his own results as a security against misapprehension or mistake.

Some members of the Committee have been preparing a small volume of Illustrations of the C. G. S. System (centimetre-gramme-second system) intended to meet this want. The Committee do not desire to be re-appointed; at all events at present.

On Siemens' Pyrometer, by Prof. G. C. Foster.

The committee appointed to report upon Siemens' pyrometer has sought to determine whether or no the resistance is altered after exposure to high temperatures. The resistance was measured by means of Wheatstone's Bridge. An arrangement was adopted whereby the heat of the connecting wires was prevented from affecting the measurements. As a long thick iron tube surrounded the platinum coil of the pyrometer, it was impossible, in order to secure a standard temperature, to plunge the instrument into ice-cold water, because, owing to the conductivity of the iron, there was no certainty that the pyrometer wire was actually at the same temperature as the water. The temperature of 10°, which was near the usual atmospheric temperature, was adopted as the standard.

Four instruments were examined: in one of them (1) the coil was surrounded by an iron sheath, in (2) and (3) a piece of stout platinum foil surrounded the cylinder between the iron sheath and the coil. In (4) there was no iron sheath, but a platinum tube instead. Nos. (1) (2) and (3) were found to be considerably altered after having been exposed to a high temperature. The instruments were placed in an ordinary fire and repeatedly heated to a red heat, at which they were maintained for several hours. The original resistance was ten units. The following numbers show the increase of resistance:—

(1) 0·834 (2) 1·608 (3) 1·169

These numbers expressed as fractions of the original resistance become (1) ·0834 (2) ·1608 (3) ·1169.

Equivalent change of temperature = (1) 30°, (2) 58°, (3) 43°. These measurements show that the change in resistance produced by exposure to high temperatures is so great as to invalidate the usefulness of these instruments.

No. (4). Resistance increased ·046, which expressed as a portion of the original resistance – ·0046. Equivalent change of temperature = 1°·5. The last instrument therefore gives results which are sufficiently constant for industrial application if not for strictly scientific purposes.

Prof. Williamson suggested that the change in the resistance might be due to a change in the platinum, as it has been found that platinum in contact with silica, in a reducing atmosphere, is altered at high temperatures.

Report of the Committee appointed to prepare and print tables of Wave Numbers.

Mr. G. J. Stoney stated that the work of this Committee was in progress, and that the Committee hoped to be in a position to make a full report at the next meeting of the Association. Under these circumstances they merely asked to be reappointed.

Second Report on the Sub-Wealden Exploration. By H. Willett and W. Topley.

This Report gave an account of the progress of the work since the last meeting of the Association. Most of the results attained have been already made public through the Quarterly Reports, and they were recently summarised in these columns. At the time of the Bradford meeting only 300 feet had been reached, and the age of the beds then being traversed was unknown. Mr. Peyton and Prof. Phillips discovered Kimmeridge Clay fossils immediately after the Report was read; since that time a large collection of fossils has been made, including most of the characteristic English Kimmeridge species, and some which are new. An undescribed species of *Modiola* is very abundant, and so is a small *Astarte*—the *A. Mysis* of D'Orbigny. A new species of this genus has been found, and a small *Trigonia* which Dr. Lycett believes to be also new.

The Kimmeridge Clay appears to be nearly 700 feet thick; generally it is a rather sandy clay, but towards the base there are some thick bands of cement stone. The Coral Rag is apparently absent. Amongst the fossils from the Oxford Clay the following were noticed:—*Ammonites Jason*, *Am. Lamberti*, *Am. Sedgwicki*, *Pollicipes concinnus*, *Gervillia*, and *Macrodon*. The total depth now reached is 1,030 feet, and 3,000*l.* has been spent. The Association has voted an increased grant of 100*l.*, and the Government has promised aid to the extent of 100*l.* for each 100 feet completed below 1,000 feet; but as each 100 feet will cost from 300*l.* to 400*l.* (including the cost of lining the hole), the Committee trust that subscriptions will still be forthcoming to enable them to continue the work.

Report of the Committee on the Influence of Forests on Rain.—It appeared from the very lengthened report that the operations of the committee during the past year had been restricted to the meteorological observations made at Carnwath, Lanarkshire. In order to carry on the operations at Carnwath, and extend them, a grant from the Association of not less than 25*l.* would be required for next year. They did not propose to commence observations at any new station.

SCIENTIFIC SERIALS

The Journal of Mental Science, July 1874—Dr. Nicolson proceeds with his Morbid Physiology of Criminals, discussing, on this occasion, prison discipline as a test of mind; and he finds a large number of prisoners who, tried by this test, he must class together as "weak-minded." In spite of his strong common sense, Dr. Nicolson at times betrays amiable leanings towards the hopeful rather than towards a perhaps unpalatable truth. We must confess ourselves among the "sceptics" from whom "the sight of a class of adult and veteran criminals plodding away at their books in the halls of a prison" "would but draw an ominous shake of the head." Granting that the book education of criminals could be carried further than there is any reason to believe possible, the assumption remains that this would tend more than any other form of discipline to make them less criminal than before—the only thing in which society has any special interest concerning them. The "weak-minded" criminal, being on the border line of sanity, is naturally a perplexing subject to the prison authorities. In dealing with him practically Dr. Nicolson's sagacity might be fully relied on, though in such expressions as "we can *punish* badness, but we must *treat* madness," there is implied a sharp line of distinction which exists only in our phraseology. Madness ought to be punished when that is the best treatment; and badness ought to be treated when treatment is the best remedy. —In an interesting paper On children fostered by wild beasts, W. W. Ireland, M.D., favours the opinion that there is not a single authentic instance of the kind.—J. H. Balfour Browne, barrister, makes a psychological and medico-legal problem of the character of Léonce Miranda, the hero of Mr. Browning's Red Cotton Night-Capt Country; and by intensely commonplace standards of measurement concludes that Léonce was mad. We sincerely hope his principles of judgment will never find place in the deliberations of actual legal tribunals. It would be a terrible prospect to think that our wills might be set aside at the instance of greedy relatives on the ground that we were somewhat "anomalous," not exactly like the herd "in our mental constitution;" "to say which," says Mr. Balfour Browne, "is only to say that a man is insane." Perhaps "all the doctrines of Rome will not make a *practical* man who *professes* its creed believe in a nowadays miracle;" but what is the worth of the statement? Strike out the word *practical*, which here means stupid, and give the sentence definite meaning by substituting *believes* for *professes*, and the proposition becomes a contradiction in terms. But to be logical may be to be insane, according to the wisdom of our practical men who profess instead of believing.—The Morisonian Lectures; The treatment of insanity, abstracted from Drs. Bucknill and Tuke's chapter on that subject; Clinical notes and cases; Notes of the quarter, and reviews, make up the number. Dr. Carpenter's "Mental Physiology" is the most important review. His defence of the old freewill doctrine is severely handled; and an attempt, not quite so successful, is made to set aside the theory of unconscious cerebration.

Journal of the Franklin Institute, July.—Among the matter contained in this number is the first instalment of an elaborate paper by Mr. J. A. Henderson, M.E., On the theory of aerosteam engines, which, an editorial note informs us, is the first theoretical treatise on the subject that has appeared to complement the work of the late Prof. Rankine on other heat-engines. The "Principles of Shop Manipulation" is continued by Mr. J. Richards.—Chief Engineer W. H. Shock, U.S. Navy, under the head of "Strength of Materials," gives an account of a series of very carefully conducted experiments on bolts of various dimensions, under the two possible conditions—double cut and single cut—in which they might be used in connection with the bracing of boilers, and for other purposes.—There is a translation of M. Baudrimont's paper, On the tenacity of malleable metals at various temperatures.—Mr. C. J. Wister, in a paper On the moon's figure as obtained in the spectroscope, objects to Gussew's deductions from De la Rue's photographs of the moon at the extremes of her librations.—Prof. Thurston's paper On the mechanical properties of materials of construction, is continued.

The American Naturalist, August.—On the Flora of Southern Florida, by Frederick Brandel. The question considered is whether the flora of Southern Florida and the Keys is really North American or South Indian; and the conclusion reached is that it is not North American, but a link between it and that of the West Indies, and that a portion of those species which are peculiar to the northern portions of the State and the immediately adjacent region may have been derived from the south.—The Classification of the Rhynchophorous Coleoptera, by Dr. John L. Leconte.—Herbarium Cases, by Dr. C. C. Parry. A case is described, with a woodcut, specially designed for being readily moved.—A Key to the higher Algæ of the Atlantic Coast between Newfoundland and Florida, by Prof. D. S. Jordan. Part II. Rhodospermeæ. Part III. Chlorospermeæ. An etymology of names of genera is appended.—Under the section Zoology a new species of North American bird is described, named *Tringa ptilocnemis*.—In the Mammoth Cave Mr. A. S. Packard met with a new Japyx, to which he has given the specific name "*subterraneus*."

Astronomische Nachrichten, No. 2,003.—This number contains a paper by W. A. Rogers, of Harvard, On the orbit of the minor planet Felicitas (109). The elements and perturbations are given. Tacchini gives a number of observations of Coggia's comet, made with the meridian circle at Palermo. Schmidt also gives a list of observations of the position of the same comet for almost every night from May 3 to July 15. Schulhof gives several sets of elliptic elements for Coggia's comet, and it appears that it may be the same body as was seen in 1734, and so having a period of 137·1 years; or it may have a period of 12184·3 years, as shown by another set of elements. The author also adds an ephemeris from Aug. 31 to Oct. 6. D'Arrest also gives observations on this comet.—Dr. Zenker contributes a note On the light of the comet being polarised in a plane passing through the sun and comet, showing the presence of reflected sunlight.—Konkoly adds a note On the spectrum of the comet.

No. 2,004 contains a catalogue by Engelmann of the positions of fixed stars.—Pogson gives his observations on Biela's comet, made in November and December 1872. At Madras, on Nov. 2, at 17h. 31m. 1·3s. Madras mean time, its R.A. was 14h. 7m. 12·66s., and P.D. 124° 45′ 21·1″; and on Dec. 3, at 17h. 13m. 11·3s. its R.A. was 14h. 21m. 55·11s., and P.D. 124° 4′ 37·5′—Prof. Watson gives the elements and an ephemeris of Aethra (132).—Winnecke and Bruhns contribute notes on the positions of Borrelly's comet, and Dr. Holetschek has calculated the following element and ephemeris:—

T = Aug. 26.7199 Berlin time.

$\pi = 343°\ 57'\ 50''$
$\Omega = 251°\ 44'\ 18''$
$i = 41°\ 55'\ 32''$
$\text{Log.}\ q = 9·99292$

	R.A. h.	m.	s.	D. °	′
Aug. 26 . .	12	33	48	+ 74	4·0
,, 30 . .	11	58	19	+ 74	20·7
Sept. 15 . .	9	50	27	+ 72	0·6
Oct. 1 . .	8	22	21	+ 66	17·0

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, Aug. 1.—The first article in this number is a statement by Capt. Hoffmeyer, director of the Royal Meteorological Institute at Copenhagen, of his plan, already noticed in NATURE, vol. x. p. 146, by Mr. R. H. Scott, for publishing daily weather charts for Europe and part of the Atlantic. It is here illustrated by a specimen chart. Next follows an examination by M. Raulin of the distribution of rain in Turkey in Europe and neighbouring parts. Observations were made at Pirano and Trieste between 1787 and 1807, and since 1841; in Corfu since 1845; at Ragusa since 1851; and at other stations, of which five are outside the peninsula, in later years. All the stations are near the margin of this large region, so that the weather of the interior is not yet well known. M. Raulin divides the year into two periods, a cold one from October to March, and a warm one from April to September. The practical significance of this division is that the rainfall of the warm period satisfies the immediate wants of vegetation, while that of the cold season goes mainly to the supply of wells and rivers. The rainfall at Fiume is very large, also at Ragusa, Janina, and Corfu, but very small at Athens and Smyrna. France has been divided into districts, each having its peculiar distribution of rain through the year, and the same method is adopted here. The first district, like the plain of Northern Europe, has more rain in summer than in winter, and includes Austria, Carinthia, Styria, Hungary, Southern Russia, and the Lower Danube, to Bucharest. Laibach belongs to the second district, having a rainfall steadily increasing from winter to autumn. To the third, with a very dry winter and summer and very wet autumn, belong St. Magdalena, Trieste, and Semlin. To the fourth, with a dry summer and rainy autumn, Dalmatia, Albania, Athens, Pera, and Scutari. Among the "Kleinere Mittheilungen" we have an interesting account of the climate of the Isthmus of Tehuantepec, from a report of the United States Government Survey Expedition; a notice of Herr Mohn's results derived from observations at Novaya Zemlya and Spitzbergen, made by Tobiesen, who died while wintering at the former place; and of Mr. Draper's paper, in which he shows the fears of a supposed change of climate in the Eastern States of North America to be groundless.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, Aug. 24.—M. Bertrand in the chair. The following papers were read:—Ninth note on guano, by M. E. Chevreul.—Study of the fossil grain found in a silicified state in the coal formation of Saint-Etienne. Second part: Description of genera, by Ad. Brongniart. The author describes *Polylophospermum*, *Codonospermum*, *Stephanospermum*, and *Ætheotesta*.—Note on the Central Sea of Algeria, by M. E. Roudaire. This is a reply to objections raised by MM. Fuchs and E. Cosson.—Researches on the effects of powder in firearms, by M. E. Sarrau.—On the passivity of iron; second note, by M. A. Renard.—Memoir on vegetable protoplasm, by M. Ganeau.—On some phenomena of localisation of mineral substances in the Articulata; physiological consequences of these facts, by M. E. Heckel. The author has been feeding insects with arsenic. The metallic powder was mixed with flour, and after repeated small doses the insects (*Mantis religiosa*, *Blatta occidentalis*, and *Cerambyx heros*) were killed and various parts of the intestinal tube examined. The Malpighian tubes only gave decided indications of arsenic.—Various communications on *Phylloxera vastatrix* were received from MM. Ador, Boutin, Rommier, Morlot, Barnier, and others.—On a new formula for obtaining by successive approximations the roots of an equation of which all the roots are real, by M. Laguerre.—On the direct combination of chromic acid with wool and silk; applications to the colouring and analysis of wines, by M. C. Jacquemin. M. C. Chevreul made some remarks on the foregoing paper.—On the ureides of pyruvic acid and its brominated derivatives, by M. E. Grimaux. Pyruvic acid heated with urea gives a substance of the formula $C_{12}H_{14}N_8O_4$. When excess of urea is employed the compound $C_{10}N_{16}N_8O_7$ is produced. With excess of acid another body is obtained, of which the composition has not yet been established. A nitro-body of the formula $C_{12}H_{10}N_8O_{11}$ has been prepared from these compounds, and likewise a ureide of tribrompyruvic acid of the formula $C_{10}H_8Br_6N_8O_6$.—Analyses of various pieces of calf flesh, mutton, and pork sold in the Paris market in 1873 and 1874, by M. Ch. Mène.—Anæsthesia produced by the injection of chloral into the veins for the removal of a cancerous tumour, by M. Oré.—Application of the graphical method to the determination of the mechanism of rejection in rumination, by M. J. A. Toussaint.—Note on the physiological action of apomorphine, by M. C. David. The author has experimented on dogs, cats, pigeons, rabbits, and guinea-pigs. The influence of various reagents on the alkaloid has also been studied.—Action of the sulphydric acid of the sources of the Luchon on granitic galleries, by M. F. Garrigou.—Observations of the Perseides made at the Observatory of Toulouse on August 5, 7, 8, and 9, 1874, by M. Gruey.—Observations made at Paris of the shooting stars of the month of August 1874; progress of the phemonenon from 1837 to 1874, by M. Chapelas.

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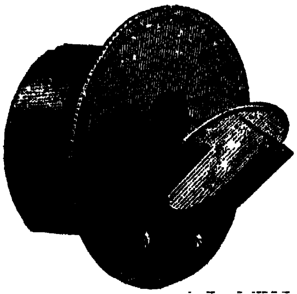

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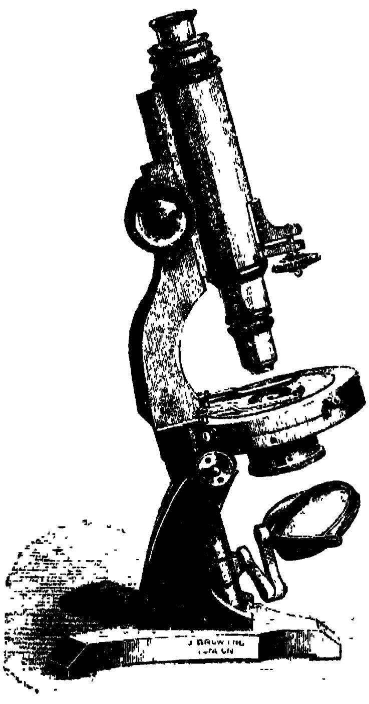

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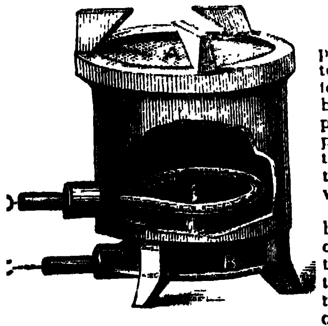

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1. The Classical Division (embracing Classics, Mathematics, English History, and Modern Languages)

2. The Modern Division, which includes English, Latin, Modern Languages, Mathematics, Natural Philosophy, Chemistry, Geology, and Free-hand Drawing.

One Freake Exhibition of £20 will be given at the commencement of the Michaelmas Term to the Student passing the best examination on entering the College.

For information, apply, personally or by post card, to J. W. Cunningham, Esq., Secretary.

KING'S COLLEGE, LONDON.

DEPARTMENT of ENGINEERING and APPLIED SCIENCES.—New Students will be admitted on WEDNESDAY, September 30.

The course of study provides practical education for young men who intend to engage in engineering, surveying, architecture, telegraphy, and the higher branches of chemical and manufacturing art.

This Department has attached to it a workshop, also chemical, physical, and photographic laboratories.

One Freake and two College Exhibitions of £20, £30, and £21 respectively, will be given at the commencement of the Michaelmas Term to the Students passing the best examination on entering the College.

For information, apply, personally or by post card, to J. W. Cunningham, Esq., Secretary

KING'S COLLEGE, LONDON.

MEDICAL DEPARTMENT.—The WINTER SESSION will OPEN on THURSDAY, Oct 1, with an Introductory Lecture by Dr. FERRIER.

Warneford Scholarships.—Students entering in October next will have the privilege of contending for two Scholarships of £25 each for three years

Five Medical Scholarships are awarded at the close of each winter session for proficiency in professional subjects, viz., one of £40 for two years, one of £30 for one year, and three of £20 for one year.

For further information apply, personally or by post-card, to J. W. Cunningham, Esq, Secretary.

KING'S COLLEGE, LONDON.

The EVENING CLASSES.—These Classes will RE-OPEN on MONDAY, October 5, in Divinity, Latin, Greek, French, German, Hebrew, Italian, Spanish, German Literature, English Literature and Composition, English History, Geography, Arithmetic, Writing, Mathematics, Commerce, Drawing, Chemistry, Practical Chemistry, Mechanics, Physiology, Physics, Botany, Zoology, Logic, Political Economy, Mineralogy, Geology, Law, and Public Speaking.

For the prospectus, apply, personally or by post-card, to J. W. Cunningham, Esq, Secretary.

KING'S COLLEGE, LONDON.

The SCHOOL.—New Pupils will be admitted on TUESDAY, September 22. There are four divisions :—

1. Upper Classical School, intended to prepare Pupils for the Universities, for the theological, general literature, and medical departments of the College, and for the learned professions.

2. Upper Modern School, intended to prepare Pupils for general and mercantile pursuits, for the department of Engineering in the College, and for the Military Academies.

3. The Middle School comprises several Classes, each with its classical and modern division, for Pupils who are too old for the Lower, but not sufficiently advanced for the Upper School. Great attention is paid in this Division to arithmetic, writing, and bookkeeping, and to the subjects required for the Home Civil Service Examinations and those for mercantile appointments.

4. Lower School.—This Division includes boys over eight years of age, and is intended to give a complete course of education up to such a point as will prepare them to enter with advantage either of the two senior divisions.

For information, apply, personally or by post-card, to J. W. Cunningham, Esq., Secretary.

THE LONDON HOSPITAL AND MEDICAL COLLEGE.

The next WINTER SESSION will commence on THURSDAY Oct. 1st, 1874, when the Introductory Lecture will be given at 3 p.m by SAMUEL FENWICK, M.D., Assistant Physician to the Hospital.

General Fee to Lectures, with two years' Practical Anatomy, and Hospital Practice, 90 guineas, payable in two instalments of 45 guineas each. Library Fee, £1 1s. Special entries can be made to Lectures or Practice.

The Hospital contains 600 beds. There are Medical and Surgical Wards for Children, Wards for Syphilis, Special Departments for Diseases of Women, Diseases of the Eye, Diseases of the Ear, Diseases of the Skin and special arrangements for Diseases of the Throat. A Maternity Department exists for the delivery of lying-in women at their own homes. 586 cases were attended last year by the Students of the Hospital.

For instruction in Mental Diseases, Students can attend without further fee the practice of Dr. John Millar, Superintendent of Bethnal House Asylum, a few minutes' walk from the Hospital.

Clinical Lectures, both Medical and Surgical, will be given every week, and practical instructions imparted in all the departments.

The In-patients during 1873 were 5,613, and the Out-patients 43,808; total, 49,421.

At the Medical College, which has been enlarged, Lectures will be given on all the subjects required by the Examining Boards.

Members of the Staff and Lecturers at the College.

Mr. J. Luke, F.R.S.
Mr. John Adams
Mr. Curling, F.R.S.
Dr. Herbert Davies
Dr. Andrew Clark
Dr. Ramskill
Dr. Langdon Down
Dr. Hughlings-Jackson
Dr. Sutton
Dr. Fenwick
Dr. Woodman
Dr. Stephen Mackenzie
Dr. A. E. Sansom
Mr. Jonathan Hutchinson
Mr. Maunder
Mr. Couper
Mr. Walter Rivington
Mr. Jas. Adams
Mr. Waren Tay
Mr. McCarthy
Mr. Reeves
Dr. Head
Dr. Palfrey
Mr. H. J. Barrett
Mr. A. W. Barrett
Dr. Letheby
Dr. Meymott Tidy
Dr. Prosser James
Dr. Morell-Mackenzie
Mr. J. E. D. Rogers
Mr. Gilbert Baker

The following Prizes and Appointments are open without any further payment to Students paying the general fee of 90 guineas :—

Seven Scholarships, to be offered for competition in the Winter Session :

1. A Scholarship of £30 to the Student of less than three months' standing who passes in October the best examination in the subjects required at the Preliminary Examination.
2. A Scholarship of £20 to the Student of less than three months' standing placed second in the above examination.
3. A Scholarship of £20 in Human Anatomy for first-year Students; to be awarded in April 1875
4. A Scholarship, value £25, in Anatomy, Physiology, and Chemistry, for first-year and second-year Students; to be awarded in April 1875.
5. A Hospital Scholarship, value £20, for Clinical Medicine; to be awarded in April 1875.
6. A Hospital Scholarship, value £20, for Clinical Surgery; to be awarded in April 1875.
7. A Hospital Scholarship, value £20, for Clinical Obstetrics, to be awarded in April 1875; and a Prize of £5 to the Student who has attended most Midwifery Cases for the Hospital during the preceding twelve months.

The Duckworth Nelson Prize, value £10, for Practical Medicine and Surgery (Biennial), 1875.

Money Prizes to the value of £60 given annually by the House Committee for zeal in Dressing Out-patients and knowledge of Minor Surgery

Certificates of Honour in all the Classes according to the results of the General Examinations at the end of the Session, and Special Certificates to those who have filled with credit the duties of the Hospital Appointments.

Four House-Surgeoncies, tenable for three or six months, and Dresserships to In-patients, open to all.

Dresserships to Out-patients, with the privilege of competing for the Prizes above mentioned.

The office of the Resident Medical Officer, tenable for two years, with a salary of £75 the first year, and £100 the second year.

The Office of Junior Resident Medical Officer, tenable for six months.

Four Medical Assistantships, held for three months, with residence and board in the Hospital for three weeks.

The office of Resident Accoucheur, tenable for six months.

N B.—The holders of all the resident offices are provided with rooms and board free of expense.

Four offices of Clinical Assistants in the Out-patients' Department, each at a salary of £40.

The office of Medical Registrar, salary 25 guineas.

The office of Surgical Registrar, salary 35 guineas.

Prosectors of Anatomy, Ward Clerks, and Post-mortem Clerks.

A Prospectus, giving details, will be forwarded on application to the Bedell of the London Hospital Medical College, Turner Street, E.

Further information may also be obtained from Mr. James E. Adams, Treasurer, 10, Finsbury Circus, E.C.; or Mr. Waren Tay, Vice-Dean, at the Medical College.

THURSDAY, SEPTEMBER 10, 1874

THE INTERNATIONAL CONGRESS OF ORIENTALISTS

THE International Congress of Orientalists, which is about to be held in London, from the 14th to the 19th of September, promises fairly to become one of the most striking events of the autumn. This philological parliament is the successor and outcome of a similar Congress held last year in Paris, which inaugurated a movement likely to bear good fruit for a long time to come. The idea of holding once during every year a meeting of this nature in a different city originated with M. Gabriel Mortillet, a distinguished French *savant*, who proposed an annual International Congress of Prehistoric Archæology. Of these, the first was held at Neuchâtel, in Switzerland, in 1866. At the Brussels Congress of this body, two monarchs, the Kings of Denmark and Sweden, commissioned agents to represent them on the occasion, and their example was followed by the municipal authorities of Bologna. The French Congress of Orientalists of 1873 was mainly due to the exertions of M. Léon de Rosny, who organised its machinery with the co-operation of MM. Madier de Montjau and Zelinsky. The most prominent considerations of this Congress were directed towards the Japanese Empire, history, and language, and a very large and extremely interesting mass of literary and scientific material was accumulated, and is now in course of publication and distribution among the members of that meeting. This collection of essays is all the more important when we consider how few really accurate channels of knowledge concerning that remote country are available to the European student. Although the French Congress was supported by a greater number of members than the approaching London Congress seems at present likely to enrol, nevertheless it was not well attended; for the principal Orientalists who occupy *fauteuils* in the Institute held aloof from various motives, while on the other hand the *savants* of Germany, in consequence of the recent war, were, however willing, yet prevented by the French national feeling from making their appearance in the capital city. Yet by far the larger number of the most eminent professors in Germany enrolled their names on the list of the supporters of the Congress.

The London Congress has, however, no difficulties of this nature to surmount, and it will without doubt show a great preponderance of learned Germans; at the same time a reference to the list of members indicates a very strong contingent from the other side of the Channel. The vital principle of these Congresses is, that each, at the conclusion of its labours, transmits its powers to a chosen individual who becomes president for the ensuing year; this president is elected after the country has been fixed upon in which the next meeting is to be held. The Paris Congress, in accordance with this principle, selected London, as the metropolis of England, to be the place where the Congress of the current year should be held; and this was done out of respect for the learning of the country, although very flattering and advantageous offers had been made by other European countries, which would have perhaps accorded an official reception more cordial than is likely to be given by the imperial authorities in this country. At the conclusion of the French Congress in September last year, Dr. Samuel Birch, K.R., Keeper of the Egyptian and Oriental Antiquities in the British Museum, a gentleman whose knowledge of the whole range of ancient remains, whether Greek, Roman, or Oriental, makes him *facile princeps* in this particular study, was elected president of the English meeting, and an executive committee was afterwards nominated to carry out the necessary arrangements. These preliminary matters are now so far advanced that the programme has just been issued, and the sittings, which will occupy the entire week, will commence on Monday next, the 14th inst. These Congresses are likely to produce several very excellent effects, by bringing together distinguished Orientalists who would probably not otherwise become personally acquainted with each other; by the mutual interchange of ideas, by the bringing about some understanding on many disputed points, and by the arrangement of some uniform system of transliteration and transcription of Oriental texts. But above all it will call public attention to the importance of Oriental studies, alas! too long neglected in Great Britain, and will elevate in public opinion the position of Oriental students and studies, which already exercise, and will hereafter still more powerfully exercise, an influence over European thought.

The number of English members is at present about 180, daily increasing and comprising all the names distinguished in Oriental studies; indeed, it would be difficult to mention any Orientalist of leading note in England who is not a member of this Congress. In addition to these, Prof. Dr. Brugsch will represent Egypt. France will be represented by upwards of thirty members, of whom we may mention M. François Lenormant, Professor of Archæology at the French Institute; Prof. Jules Oppert, whose labours on the Cuneiform languages are well known; and Prof. Léon de Rosny, who was president of the Congress last year. Germany is also well represented, sending such men as Prof. Brockhaus of Leipzig, a leading expounder of the old school of Sanscrit learning, with whom we may unite the name of Prof. Stenzler of Breslau; Prof. Dillmann of Berlin, chiefly known for his Ethiopic researches and his valuable lexicon and catalogues of Ethiopic MSS. in the British Museum and the Bodleian Library; Herr Euting, Librarian of Strassburg, who has specially studied Phœnician inscriptions; Prof. Haug of Munich, whose particular branch of study is the Sanscrit, Zend, and Pehlvi languages; Prof. Krehl of Leipzig, an illustrious Arabic scholar; Prof. Lepsius of Berlin, an Egyptologist of universal repute; Prof. Nöldeke of Strassburg, who takes prominence for his knowledge of Arabic and Syriac, and has lately published works on the modern language of Syria; Herr Pertsch, Librarian of Gotha; Prof. Roth of Tübingen, whose Sanscrit Lexicon of the University of St. Petersburg is perhaps the best work of its kind; Prof. Spiegel, famed for deep studies in the Zend-Avesta and languages of Persia; Herr Trumpp of Munich, privat-docent, and lately appointed Professor of Arabic and Persian, who has published many works in the language of Afghan, Sindhi, and Punjabi; Prof. Weber of Berlin, a Sanscrit authority of the new school; Prof. Weil and Prof. Windisch, both of Heidelberg, the former noted for Arabic learning, the other for Sanscrit and Celtic studies.

The programme of meetings is as follows :—

Sept. 14.—Inaugural Meeting. With Address. 8.30 P.M., at the Royal Institution, 21, Albemarle Street. The meeting will commence with the election of the Council.

Sept. 15.—Semitic Section. President, Sir Henry Rawlinson, K.C.B. Secretary, W. S. Vaux, Esq., F.R.S. Sitting, 2.30 P.M., at the rooms of the Royal Society of Literature, 4, St. Martin's Place, Charing Cross.

Sept. 16.—Turanian Section. President, Sir Walter Elliot, K.C.S.I. Secretary, Prof. Douglas. Sitting, 8.30 P.M., at King's College, Strand.

Sept. 17.—Aryan Section. President, Prof. Max Müller. Secretary, Prof. Eggeling. Sitting, 2.30 P.M., at the Royal Institution, 21, Albemarle Street.

Sept. 17.—Hamitic Section. President, Dr. Birch, LL.D. Secretary, W. R. Cooper, Esq. Sitting, 8.30 P.M., at the rooms of the Society of Biblical Archæology, 9, Conduit Street.

Sept. 18.—Archæological Section. President, M. Grant Duff, Esq., M.P. Secretary, E. Thomas, Esq., F.R.S. Sitting, 11 A.M., at the rooms of the Royal Asiatic Society, 22, Albemarle Street.

Sept. 19.—Ethnological Section. President, Prof. Owen, C.B. Secretary, R. Cull, Esq., F.S.A. Sitting, 2 30 P.M., at the rooms of the Royal Asiatic Society, 22, Albemarle Street. At the close of the sitting the members of the Congress will decide in what country the next Congress shall be held, and will nominate the president.

There will be receptions on the following occasions :—

Sept. 15.—10 A.M., at the British Museum.

Sept. 16.—11 A.M. The Right Hon. Sir Bartle Frere will give a breakfast to the members of the Congress, at his residence, Wressil Lodge, Wimbledon.

Sept. 17.—10 A.M., at the India Office Library. 12 noon, at the Soane Museum.

Sept. 18.—Mr. Bosanquet will give an afternoon garden party to the members of the Congress, at his residence, Claymoor House, Enfield.

Sept. 19.—10 A.M., at the South Kensington Museum.

During the meeting of the Congress a Bureau will be opened at the Royal Asiatic Society's Rooms, 22, Albemarle Street, W., where every information concerning the Congress may be obtained.

The Committee of the Scientific Club have kindly invited the members of the Congress to make use of their club house, 7, Savile Row, W., during the session of the Congress. The foreign members of the Congress and their friends are invited by the Council of the Royal Botanic Society of London to visit the gardens of the Society, in Regent's Park, at any time during their stay in London. Such members will be admitted to the gardens by producing their cards of membership.

ANDERS JONAS ANGSTRÖM

ANDERS JONAS ANGSTRÖM, Professor of Physics in the University of Upsala, after a short illness of less than a fortnight, died, as we have already announced, on June 20, from an attack of inflammation of the brain. The death of Prof. Angström, who has been cut down in the full vigour of his powers and in the midst of a noble and active scientific career, is a loss to the entire world of science.

Angström was born Aug. 13, 1814, at the Lögdo Iron Works Settlement in Medelpad. He was the son of a pastor, who in the early childhood of Anders Jonas, removed to Ullänger, in Angermanland, and a few years afterwards to Sättna in the neighbourhood of Sandsvall, where he remained till his death in 1847. With no other means than the extremely limited stipend of a Swedish country minister, supplemented by the proceeds of a small glebe, the elder Angström kept his three sons—the present Dr. Johan Angström and Prof. Anders Jonas and his young brother Carl Arendt at school, and even assisted them in their subsequent attendance at the University classes at Upsala. In these efforts the father was strenuously supported by his wife, without whose good management such efforts would have been impracticable; and to advanced age this admirable housewife continued to prosecute her daily task of spinning, without remitting her active supervision of her household.

Although circumstances compelled Angström to eke out the means necessary for his University course by his own exertions, he passed through all his requisite examinations with distinction and within the usual terms. After matriculating in the autumn of 1833, he took the degree of Doctor of Philosophy in 1839; became a physical tutor in the same year, and assistant in practical astronomy in 1843; while in the years 1846 and 1847 he fulfilled the duties of the Chair of Astronomy at the University, during the temporary absence on the continent of the professor. Owing to want of interest he had, however, five years to wait before he obtained any other fixed employment. The Chair of Physics had fallen vacant in 1839, the same year in which Angström graduated; but then, and for some time afterwards, his abilities were not fully recognised in the University, while with his natural modesty he abstained from presenting himself as a candidate, although he might then have enjoyed the same good fortune as his friend and fellow-student, Malmsten, who, after having had four years in which to prepare himself, was able on the death of the Professor of Mathematics, in the year 1843, to offer himself as a successful candidate for the vacant chair. At length, in 1858, on the public recommendation of the Consistory, Angström was nominated to the Chair of Physics, the duties of which he had performed for two years in the character of a *pro tempore* professor. This chair he continued to hold for the remaining sixteen years of his life.

During his occupancy of the chair Angström secured for the physical museum of the University an admirable collection of instruments for the determination of different exact measurements in the various departments of physical science; and as far as the limited resources at his disposal permitted, he improved the physical laboratories, and strove to awaken amongst the students an interest in the study of the exact sciences. He also continued for a number of years, in the capacity of Secretary to the Royal Society at Upsala, to conduct its transactions with a zeal and devotion which secured for him the grateful recognition of foreigners as well as of his own countrymen.

Although Angström published memoirs on almost all branches of physical science, his name will be for ever associated with the history of spectral analysis, for which he obtained from the Royal Society of London in 1870 the Rumford gold medal, a distinction which no Swede had ever before enjoyed.

In order to show Angström's place in scientific history in regard to this class of researches, it will be well in this place to briefly recapitulate the capital points.*

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* This recapitulation is based upon the historical statement in Lockyer's "Solar Physics."

Fraunhofer, at the beginning of this century, pointed out the coincidence of place in the spectrum between certain dark lines which he saw in the spectrum of the sun and the bright lines in the spectrum of the flame of a lamp. In Dr. Brewster's note-book, dated St. Andrews, Oct. 28, 1841, this passage occurs:—"I have this evening discovered the remarkable fact that, in the combustion of nitre upon charcoal, there are definite bright rays corresponding to the double lines of A and B, and the group of lines *a* in the space A B. *The coincidence of two yellow rays with the two deficient ones at* D, *with the existence of definite bright rays in the nitre flame, not only at* D *but at* A, *a and* B, *is so extraordinary that it indicates some regular connection between the two classes of phenomena.*"

We next have an important experiment made by Foucault in 1849, who pointed out that the electric arc presented us with a medium which emits the rays D on its own account, and which at the same time absorbs them when they come from another quarter.

The received explanation of this coincidence between the two bright lines of burning sodium vapour, and the two dark lines D in the solar spectrum, which extended the grasp of spectrum analysis from terrestrial substances to the skies, was taught by Prof. Stokes in his lectures about 1852, but was not published.

In 1853 the idea was first published by Angström.[*]

In his memoir, for the purpose of illustrating the absorption of light, he made use of a principle already propounded by Euler, in his *Theoria lucis et caloris*, that the particles of a body, *in consequence of resonance*, absorb principally those ethereal undulatory motions which have previously been impressed upon them. He also endeavoured to show that *a body in a state of glowing heat emits just the same kinds of light and heat which it absorbs under the same circumstances.* He further undertook researches on the electric light, and stated that in many cases the Fraunhofer lines were an inversion of the bright lines, which he observed in the spectrum of various metals.

Early in 1859, Mr. Balfour Stewart independently discovered the law which binds together radiation and absorption, establishing it experimentally as an extension of Prévost's law of exchanges in the case of the heat rays, and generalising his conclusion for all rays.

In October of the same year, 1859, Kirchhoff established experimentally the same law for the light rays.

On the occasion of Angström's admission to the membership of the Royal Society, General Sabine in his introductory address mentioned that the obstacles opposed by the language in which Angström's treatise had been written, and by distance from the scene of his investigations, had for three years prevented its very existence from being known to the scientific world at large; but when once the nature of that treatise became known, the fact was immediately acknowledged, that in Professors Stokes and Angström we are bound to recognise the fathers of spectral analysis. Indeed, in the "Optiska Undersökningar" of the latter are to be found many of the fundamental principles of much that has since been accomplished in that department of scientific inquiry. In his work entitled "Recherches sur le spectre solaire," with its atlas of the normal spectrum of the sun, Angström has given us an indispensable adjunct for all future students of spectrum analytical investigations.

We have already stated that Angström published memoirs on subjects connected with nearly every department of physical inquiry. Thus we have papers:—(1) "Sur la polarisation rectiligne et la double réfraction des cristaux à trois axes obliques" (Upsala Vetenskaps-Societets Acta), in which he gives the solution of the problem involved in the optical phenomena presented by such crystals which had been sought, but without success, by Neumann and MacCullogh. (2) On the "Monoklinoedriska kristallernas molekulära Constanter" (Vet. Akad.'s Handlingar, 1859). (3) "Ny metod at bestämma kroppars ledningsförmaga för Värme"—New method of determining the capacity for conducting heat in the human body—(Vet. Akad. Förh. 1861); which contains the first determinations ever given of the absolute values of the capacity for conducting heat. (4) "Sur deux inégalités d'une grandeur remarquable dans les apparitions de la Comète de Halley" (Upsala Vet. Soc. Acta.). This treatise first excited the expectation amongst astronomers of obtaining certain results by means of a single method. (5) "Sur les Spectres des gas simples" (*Comptes Rendus*, 1871).

These are among the most important of Angström's numerous treatises, and in addition we may instance his celebrated monograph, "Mémoire sur la temperature de la terre" (Upsala Vet. Soc.'s Acta.), as well as a paper belonging to an earlier period, which appeared in the "Denkschriften der Münchener Academie," 1844, under the title of "Magnetische Beobachtungen bei Gelegenheit einer Reise nach Deutschland und Frankreich."

As might naturally be expected, numerous scientific Societies sought the honour of numbering Angström amongst their members, as for instance:—Kungl. Vet. Akad. i. Stockholm; Kungl. Vet. Akad. i. Upsala; the Royal Societies of Berlin, Copenhagen, London, &c. He was, moreover, appointed Corresponding Member of the French Institute; he twice obtained the Wallmarsk prize of the Vet. Akad. of Stockholm in 1865, in conjunction with Professors Thalén and H. Holmgren, and in 1869 with the former alone. He carried off two other prizes given by the same Society, and once he obtained a grant of money for his observations from the University of Upsala, before he had become a member of the Upsala Vet. Soc., which was the more acceptable to him, since for a long period he reaped a very inadequate pecuniary return for his scientific labours. Partly by the aid of the State, but mostly at his own personal expense, Angström several times visited the Continent, especially France and Germany. He was absent from Sweden in the years 1843, 1844, 1859, and during the summers of 1866 and 1867; but with one exception he attended all the meetings of the Scandinavian Association for Natural and Physical History. In recognition of his great merits, Angström was made Knight of the "Order of the North," and Commander of the Vasa Order 1st Class, and of the "Crown of Italy."

THE IRON AND STEEL INSTITUTE

THIS prosperous and useful association held its sixth summer meeting last week, from the 1st to the 4th instant, at Barrow-in-Furness, a town whose rapidity of growth is unparalleled out of America. Twenty-five years ago the village of Barrow, near the southern extremity of the peninsula of Furness, in Lancashire, had a population of barely 200; now the municipal borough extends over an area of about 15,000 acres, with a population of about 35,000. Even fourteen years ago, when the first volume of *Chambers' Encyclopædia* was published, it seems to have been so little known, or of so little importance, as not to find a place in that useful work. It is now a well-laid-out town, with fine docks, and some of the most important iron and engineering works in the kingdom; while one of the steel works are considered to occupy a leading position in connection with the manufacture of Bessemer steel. This unequalled growth of the town of Barrow is entirely owing to the rapid development of the various industries connected with iron, the mineral deposits of the district being unusually rich.

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[*] "Optiska Undersökningar:" Trans. Royal Academy of Stockholm, 1853. Translated in Phil. Mag. 4th series, vol. ix. p. 237.

Such a town forms an appropriate meeting-place for an Institute which has done so much to develop the manufacture of iron and steel, by affording a medium for the interchange of ideas between those who are engaged in the practical work of these industries or in the investigation of the scientific principles on which they must be founded if they are to be successful. The Institute is to be congratulated on the scientific tone which has all along pervaded its proceedings and its publications since it was founded in 1869. Though it has had such a comparatively short existence, it seems to have been in all respects prosperous (it now numbers close on 600 members), and to have most satisfactorily fulfilled the purpose for which it was instituted, the improvement of the all-important manufacture of iron and steel by the free interchange of ideas generated by experience or scientific study. To quote the words of our contemporary *Iron*: "Anterior to the establishment of this important society, the manufacturers of iron in its various forms had scant opportunity of communicating in public the results of their own experience, and of comparing those results with the observations of other persons equally interested in their development. Various methods of working prevailed in different parts of the country, and not long ago many processes connected with iron and steel manufacture were regarded as trade secrets to be carefully treasured up and jealously guarded. To the abolition of these narrow and antiquated notions the Iron and Steel Institute addressed itself vigorously from its very inception. It soon became apparent that among the first promoters of the society there prevailed an earnest desire to cast aside all petty jealousy, and to add unreservedly their individual knowledge to the general stock of information. Adherence to this excellent principle produced a prompt effect on the minds of iron and steel makers in all parts of the British Empire, and secured the sympathy of continental and American manufacturers." This is a very valuable result to have been accomplished in so short a time, and may perhaps partly be accounted for by the high scientific character of those who have from the first been elected to hold office in the society. With such names on its list of office-bearers as his Grace the Duke of Devonshire, Mr. Isaac Lowthian Bell, F.R.S., Mr. Bessemer, Mr. John Jones, F.G.S. (general secretary), Mr. David Forbes, F.R.S. (foreign secretary), Dr. C. W. Siemens, F.R.S., and others, the Institute has every chance of doing good work and of imbuing its members with a feeling of the necessity, in order to secure the highest success in their important industry, of importing into it continually the results of the latest and highest scientific research. There is little fear of the practical side of the iron and steel manufacture being neglected; and if this as well as other similar Institutes, do their work faithfully, and if the members enter upon their work equipped with a thorough scientific as well as professional training, there will be little fear of other nations outstripping us in this, as they threaten to do in other industries. To keep up the tone of the Institute, the importance of electing right men to hold office in it cannot be too much insisted on, and we hope that in this respect it will go on as it has begun.

The Barrow meeting seems to have been a real success; the only complaint being, as is almost always the case at such meetings, the difficulty of getting sleeping accommodation for the members; in Barrow this is not to be wondered at, as the people have scarcely had time yet to think about building hotels. The Duke of Devonshire, who is intimately connected with Barrow, the Earl of Lonsdale, the Mayor, and other dignitaries, as well as the railway companies and proprietors of the numerous works in and around Barrow, entertained the members most hospitably, and gave them every opportunity of inspecting the working of the numerous vast establishments connected with the industries with which the Institute is concerned. Indeed, the greater part of the four days seems to have been spent in visits and excursions; and considering the nature and aims of the Institute, its time could not, perhaps, have been more profitably spent. A good many papers were also read, all of them of considerable practical value, but of too purely technical a nature for these columns. Among the more generally scientific we may mention Mr. Wurzburger's very interesting and well-informed paper on the Geology of the West Coast Iron Ore Districts, and Mr. Charles Smith's paper on the Iron Ores of Sweden. The last day, September 4, was entirely devoted to an inspection of various mining works in the West Cumberland district.

Altogether we have no doubt that the members of the Institute will look back upon the Barrow meeting as one of the pleasantest and most instructive they have had. The Right Hon. Earl Granville has been elected president for the years 1874-6.

SHARPE'S "BIRDS IN THE BRITISH MUSEUM"

Catalogue of the Birds in the British Museum. Vol. I.—Accipitres. By R. Bowdler Sharpe. (Printed by order of the Trustees.)

THE great value of Dr. Günther's "Catalogue of Fishes" in the British Museum is appreciated by all working zoologists; and when Mr. Sharpe was appointed one of the Senior Assistants in the Natural History Department of that noble institution, ornithologists had every reason to hope for an equally important work on the birds in the same collection, all fully realising Mr. Sharpe's perfect competency for the execution of so arduous a task. The volume before us shows that their hopes were not misplaced. The "Hand-List of Birds," by the late Mr. G. R. Gray, invaluable as it is on account of its extensive indexes and easy method of reference, has a very definite and narrow limit of utility; it is an essential supplement to a library, but gives no detailed information itself. The work before us has a very different scope. Besides the nomenclature and the synonomy of the whole bird-class, it will contain the complete description of each species from the hand of one of our most able and enthusiastic ornithologists, based upon the finest collection in the world, the deficiencies of which, through the liberality of the trustees and the energy of its superintendent, are being so rapidly diminished, that, as we are told in the introduction, of the 354 certain species of diurnal birds of prey at present known, less than thirty are desiderata in the collection. Woodcuts, scattered through the volume, help to illustrate many of the peculiarities of the heads, tarsi, and toes of the species to which they refer; whilst twenty or so coloured plates, from the pencil of Mr. Keulemanns, assist in indicating the special characters of type-specimens and rare forms.

A glance through the work tends strongly to confirm our prejudice against the existing rules of avian nomenclature, and makes us hope that before long some improvement in the direction of simplification will be adopted. The system of Linnæus was a binominal one, no doubt; but though that at present in vogue still retains that name, it has gradually drifted into a quadrinominal system. The number of species of birds is certainly large, but hardly beyond the grasp of a binominal nomenclature. As it is, each bird receives its two Latin names, generic and specific, added to which is that of the author who originally described it as such, in brackets or not, according to whether he placed it in some other genus or in the one in which it is retained. Could not some universal congress be formed to determine once for all a name for each species, based on the laws of priority, present knowledge, and euphony, and so fix the appellation of all now known birds, as a starting-point for future workers, so that it need no longer be felt that the publication of every new book which has any pretension to sound work will bring with it changes in the naming of even our most familiar species, which are as confusing as they are unimportant? In the work before us the well-known smallest of the diurnal birds of prey is shown to have to be placed in a new genus, *Microhierax*, instead of retaining its habitual name *Hierax*, whilst the King Condor must in future be *Cathartes* instead of *Gyparchus*, the Black Buzzard changing to *Catharistes* or *Catharista*, according to the appreciation of gender in the author transcribing it.

The Turkey Buzzard fares still worse. Its generic distinctness from the last-mentioned bird must have struck Mr. Ridgeway in the United States and Mr. Sharpe in this country almost simultaneously. Both authors must have had the works in which they announce their proposed change in proof at the same time. The "History of North American Birds," however, appeared shortly before the volume under present review, and consequently the still-born *Œnops* has to sink into a synonym of *Rhinogryphus*. A similar fate has awaited *Urubitinga uricincta*, which will have to stand as *Antenor* instead of *Erythrocnema*. Among other fresh genera we find *Lophotriorchis*, which includes *Spizaëtus kieneri* and *S. isidorii*; and *Urotriorchis*, containing only *Astur macrurus*; and others. With regard to species, Mr. Sharpe has separated off the smaller brown Condor as *S. aequatorialis*; the Turkey Buzzard, with yellow head and white irides, as *R. pernigra*; an *Astur*, obtained by Mr. Wallace in Lombock and Bouru, as *A. wallacii*; and a Falcon, which Prince Bonaparte and Prof. Schlegel consider a melanism of *F. severus*, as *F. religiosus*.

Next with regard to the classification which is adopted; as the work does not profess to be more than a catalogue and a key for the identification of the species, it would not be fair to expect that in the separation of the different families and genera described all the known peculiarities should be given; sufficient for the ready identification of each being all that is required. Consequently when the sub-family *Polyborinæ* of the family *Falconidæ* is divided up as in the following table, without any further definition, it is evident that the author only attempts to give a minimum, and not a maximum number of distinguishing features.

POLYBORINÆ.

Key to the Genera.

a. Middle tail-feathers not elongated.
  a′. Nostrils oval. . . . POLYBORUS.
  b′. Nostrils round . . . IBICTER.
b. Middle tail-feathers extremely elongated; head with elongated plumes.
  a′. Nostrils vertical ovals; forehead with erect crest . . . . . . CARIAMA.
  b′. Nostrils perpendicular ovals; forehead not crested . . . . . SERPENTARIUS.

In the above instance we are astonished, as many others will no doubt be, not so much at the slightness of the differentiation of the genera, as at the fact that *Cariama* and *Serpentarius* are placed in such intimate relation with the Caracaras. The illustrious Nitzsch, whose opinions on classification are more to be relied on than those of any other zoologist, it is true, placed the Secretary Bird with the Accipitres, though he retained the Cariama with the Bustards. More recently there has been a tendency, which is daily becoming stronger, to combine the one with the other. The question then arises, are they Bustards or are they birds of prey? Internal structure is overpoweringly in favour of the former position; and such being the case, it is almost to be regretted that no further notice has been taken by Mr. Sharpe of their peculiarities than the statement that in two out of the four genera of the Polyborinæ, the median tail feathers are elongate, whilst in the other two they are short, especially when *Pandion* is placed in a sub-order by itself; and, as it happens, has its foot accidentally represented without the ungual phalanges or any of the three anterior toes. For though *Serpentarius* presents strongly marked external facial resemblances to *Polyborus*, which, by the way, are not to be found in *Cariama*, nevertheless in other respects they both differ so much from all other true Accipitres, that it would be impossible, even if they were birds of prey, to do otherwise than place them in a sub-order by themselves; which is the same thing as saying that their relationship to the Caracaras is not more intimate than to the eagles and the hawks.

Similarly, the American Vultures, or *Cathartidæ*, if they are vultures at all, which is extremely improbable, can hardly be included in the same family with their typically accipitrine namesakes, but must be placed independently by themselves. The conformation of the feet alone, and more especially the difference in the proportionate length of the phalanges pointed out by Prof. Huxley, is alone sufficient to decide this point.

Leaving these minor points out of the question, however, as having little or no bearing on the true value of the whole, we look on the volume before us as the precursor of others, which if all completed in the same thorough and able manner that is throughout manifested in the first, will form a standard ornithological work, the importance of which it will be impossible to overestimate. We wish Mr. Sharpe all success in the further prosecution of his almost herculean task.

OUR BOOK SHELF

1. *The Principal Timber Trees.* 2. *Select Plants (exclusive of timber trees).* 3. *Additions to the Lists of the principal Timber Trees and other Select Plants readily eligible for Victorian Industrial Culture.* By Baron Ferd. von Mueller. (Melbourne.)

THESE papers, drawn up by Baron Mueller, and first published in the Proceedings of the Zoological and Acclimatisation Society of Victoria, are something more than mere lists, inasmuch as in their separate pamphlet form, in which form they have all since been issued, the first occupies 58 pp. 8vo, and was issued in 1871; the second, 428 pp. 8vo, issued in 1872; and the third, the "Additions," 40 pp. 8vo, issued only a month or two since, and only just come to hand.

It is not on account of any original observation being made into the properties or uses of the trees or plants enumerated that we think these papers worthy of notice, but rather on account of their practical use in imparting to an unscientific colonist a knowledge, not only of such trees and other plants as may grow in the climate, but also of their value in an economic or commercial point of view. By means of a pamphlet like either of the above, we have ready references to plants, natives of nearly every part of the globe, which are, moreover, with some authority considered suitable for acclimatisation in Australia and other countries. Such information as the geographical distribution, habit of the plant, &c., could only be obtained by reference to the numerous Floras and bulky botanical works which are as sealed books to the colonists generally, while the economic applications would have to be sought for in numerous other and totally distinct works, for our Colonial Floras seldom or never even touch on this important part of the subject. Baron Mueller, indeed, says that these lists are intended not so much to contain records of original research as "to bring together information more condensed and more recent than would be attainable in costly or voluminous works of even several languages."

The arrangement of the genera is alphabetical instead of being scientific, and the following examples will show the sort of information given:—

"*Buxus sempervirens* L.—The Turkey Box Tree. South Europe, North Africa, South-west Asia. This slow-growing tree should be timely planted to provide the indispensable box-wood for wood-engravers and musical instrument makers, as yet no good substitute for it having been discovered. The box tree needs calcareous soil for its best development. Among allied species, *B. balearica* attains a height of eighty feet."

Then follows a list of other species of *Buxus*, about which, however, little is known as to the value of the respective woods. Here is another example, taken haphazard:—

"*Guevina avellana* Molina.—Extends from Middle Chili to the Chonos Archipelago. Briefly alluded to already in the list of trees desirable for Victorian forest culture. One of the most beautiful trees in existence. The snowy white flower-spikes produced simultaneously with the ripening of the coral-red fruit. In the cooler southern regions the tree attains considerable dimensions. The wood, tough and elastic, used for boat-building. The fruit of the allied *Brabejum stellatifolium* can only be utilised with caution in a roasted state as an article of diet, because it is noxious, or even absolutely poisonous, in a raw state."

Guevina avellana is a Proteaceous tree, the fruits of which are very similar in appearance, and the seeds very similar in flavour, to those of the Australian tree *Macadamia ternifolia*. These lists will probably prove useful not only as a guide to the selection of plants for the purposes of acclimatisation, but also as a handy reference for economic species generally. J. R. J.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

A Remarkable Thunderstorm

[The following letter has been forwarded to us for publication by Mr. R. H. Scott, F.R.S.—ED.]

"Yorkshire Philosophical Society,
York, Sept. 2, 1874.

"Dear Sir,—I have to report to-day one of the most unusual thunderstorms that I ever remember. It began to be dark about 12 30 noon, and rain fell; at 12.40 it was much darker; at 12 43 rain fell in torrents, but was so much driven by the wind that you saw it being driven like snow in packs; so dense was it now and for ten minutes that I could not see chimney-pots 100 yards distant. The thermometer must have fallen tremendously, for windows were so steamed inside as to be opaque. I remarked that the clouds went in the direction of N.W., while the wind was S.S.W., and force about 8. Part of the time it went in whirlpools, as it were; during the climax of ten minutes we had rain with lightning and thunder, then snow, and snow and sleet, and distinct hail afterwards, but not of large size.

"I should have taken the state of the instruments, but I was about half a mile from the museum.—I am, &c.,

(Signed) "C. WAKEFIELD

"R. H. Scott, Esq., F.R.S.,
"Director, Meteorological Office.

"P.S.—Rain measures ·49. There was lightning (a little forked, the rest sheet) and thunder during all the storm."

The Exhibition of Specimens and Apparatus at the British Association

IF no one else has already done so, will you permit me to call attention to the valuable feature of the Belfast meeting of the British Association presented by the exhibition of specimens, apparatus, and diagrams in the Anatomical Museum, due, it is understood, to the energy and perseverance of Mr. Ray Lankester. Here were to be seen, for instance, Mr. Symons's series of thermometers illustrating variations in sensibility, a collection of bones and other remains found in Kent's Hole and the Victoria Cave, during 1873-74, Dr. Pye Smith's large undescribed Medusa, the diagrams and plants which illustrated Dr. Hooker's address on Carnivorous Plants, specimens of breech-loading fire-arms, and many other objects of interest, all catalogued in each day's issue of the "Journal." It is to be hoped that a similar collection, rendered still more complete through the co-operation of the authors of papers, will be an addition to the attractions of all future meetings of the Association.

Penmaenmawr, Sept. 4 ALFRED W. BENNETT

Photographic Irradiation

In Nature, vol. x. p. 245, Mr. W. C. Crofts adds his experience to those previously given in your journal, and gives his conclusion as opposed to that of Mr. Aitken (vol. x. p. 185). Like most conclusions based on incomplete evidence, it does not conclude anything. The fact is as I have stated it in my previous note (vol. x. p. 205) on the subject, and when I return to England I will be most happy to demonstrate it to anyone who cares to examine the question thoroughly. Mr. Crofts' experience with the Liverpool dry plates agrees with my own, for these plates are prepared with a pyroxyline which gives a minimum of irradiation when "backed," and give the best quality of image for scientific purposes attainable with a bromide film; but certain qualities of pyroxyline prepared in precisely the same way will show irradiation that nothing can cure, even when used for making transparencies by contact, where, of course, there can be no question of influence of any optical defects. The unquestionable fact that a collodio-albumen film acts in so totally different a manner from one of bromized collodion should prove that the lens has next to nothing to do with it.

My conclusions may be very imperfect, but so far as they go they are definite, and are drawn, not from two or three, but from hundreds of experiments with all kinds of dry plates and many different samples of pyroxyline, and whatever they may be worth, they fully support Mr. Aitken's views.

New York, Aug. 19 W. J. Stillman.

Pfluger on the "Salivary Glands" of the Cockroach

I was much interested in reading Prof. Redfern's able address at the British Association this year, more especially with that portion which dealt with the observations of Prof. Pfluger on the histology of the so-called "salivary glands" of the cockroach. In the year 1871 I wrote a short paper in Professors Humphry and Turner's Journal (vol. v. p. 242 *et seq.*) upon these organs. In this I ventured to doubt the truth of the generally accepted hypothesis as to their functions. My reasons for so doing may be summarised as follows:—1. The appendages in question are perforated throughout by ramifying spirally coated tubules differing only from tracheæ in this respect; during their passage through the organs in question they receive a layer externally of yellowish tissue, which may be, as Prof. Pflüger suggests, epithelial glandular tissue. 2. These tubules with the sacculi opening into them can be more or less fully injected with a liquid by simply immersing the insect in a suitable menstruum, and placing it under the exhausting receiver of an air-pump. This experiment demonstrates indubitably that this tubular system contains an *elastic fluid*, which for anatomical and other reasons I conclude to be air. 3. As far as my experience carried me, the sacculi, the supposed reservoirs of the saliva, never contained naturally any liquid whatever, but upon opening the thorax were invariably found to be collapsed and apparently empty. This is precisely what would occur supposing that during life they were filled by and communicated readily with the external air.

I have not yet had an opportunity of referring to Prof. Pflüger's paper, and I am consequently obliged to accept his statements at second hand. In noticing the intimate connection there is between these organs and the nervous system of the insect, he confirms what I have myself observed. It is some years since I last anatomised a cockroach, and meanwhile I suppose these insects have utilised their organs in the way mentioned by Prof. Pflüger, and we can now see "transparent drops . . . transuding from the ends of cells when the saliva has been made to flow by irritation of the gland." On looking over my microscopic specimens I find that I still have by me one showing the so-called "salivary duct" and a sacculus injected in the way I have mentioned. Any one may satisfy himself that this result is feasible by trying the experiment. In doing so the only caution required is to exhaust the air gradually and to keep the immersed insect in a partial vacuum for a few hours. Failure under these circumstances is almost impossible.

London, Sept. 2 W. Ainslie Hollis

THE CONFERENCE FOR MARITIME METEOROLOGY

THE Conference, held at the Meteorological Office, 116, Victoria Street, for the purpose of reconsidering the decisions regarding maritime meteorology made at the Brussels Conference in 1853, has concluded its sittings, and the Report of its proceedings will be presented to the Permanent Committee, appointed by the Meteorological Congress of Vienna (of 1873), which holds its meeting at Utrecht in the course of the present week. The Conference consisted of twenty-five members, belonging respectively to every maritime country of consequence in Europe, except Sweden and Turkey. India and China were also represented. Prof. Buys Ballot was elected president, and Capt. Hoffmeyer and Mr. Scott, F.R.S., secretaries. It met on the 31st ult., and at once subdivided itself into two sub-committees, dealing with the various questions connected with (1) "Observations," and (2) "Discussions." Each sub-committee held four sittings, and at the closing meeting of the Conference the several resolutions framed by the sub-committees were adopted, in most cases unanimously. Inasmuch as the Conference was an outcome of the Vienna Congress, these resolutions will not be published until they have been communicated to the Permanent Committee as above mentioned. Their general scope is towards the attainment of greater uniformity in the methods of meteorological observation at sea, and of subsequent publication of the results. On Thursday, by kind permission of the Astronomer-Royal, the members went to Greenwich in the morning, where they were conducted over the magnetical and meteorological department by Mr. J. Glaisher, F.R.S. In the afternoon they spent some hours at Kew Observatory, where they were received by Mr. Jeffery, the superintendent, and in the evening the whole party was entertained at dinner at the Star and Garter, by some of the members of the Meteorological Committee. On Friday several members availed themselves of the great courtesy of the War Office, and repaired to Woolwich, where they were conducted over the Arsenal by Colonel Field and other officers connected with that department. Finally, on Saturday, they inspected the Meteorological Office, where the meetings of the Conference had been held, and paid special attention to the arrangements there existing for reproducing the records of the photographic and other instruments at the several observatories in the United Kingdom.

ON SEWAGE AND SEWAGE FARMING

No. 1.—*Northampton.*

AFTER having had practical experience of the fertilising effects of sewage and liquid manure, I have for several years devoted part of my leisure time to an examination of the arrangements adopted by the principal cities and towns for disposing of sewage. At first I looked at it from the agricultural stand-point; but as I proceeded with the inquiry I had to widen the range of view.

The place I visited last is Northampton. I propose at present to write a concise note of what the authorities of that town have done.

Northampton has a Board of Commissioners for dealing with sewage and kindred nuisances, which is distinct from the corporation. I believe their number is limited to twelve; of whom six belong to one political body, and six to the other. These twelve Commissioners, as a body, must, therefore, be non-political; six of one being equal to half-a-dozen of another.

The town contains at present about 50,000 people. Many experiments were made at the expense of this body for purifying the sewage. At last they adopted the scheme which I proceed to describe.

Near the town there is a number of tanks in which the sewage is allowed to settle for some time so as to enable the more bulky of its solid contents to fall to the bottom and be collected. Deprived of these solid matters, the sewage is conveyed in a main culvert, about four miles from the town, where it is received on a tract of ground containing upwards of 300 acres, which was purchased at a cost of 130*l.* an acre. I may mention that all the figures were obligingly communicated to me, verbally, by the chief officer of the Commissioners. Up to the present the outlay has amounted to upwards of 84,000*l.* The soil is not naturally the best adapted for sewage-farming; it does not, however, offer any insuperable obstacle to success. The sewage is received at the highest point of the farm, from which it flows by gravitation to the lowest, which is several feet below the river that runs by, and into which the sewage passes after it has undergone clarification.

The sewage is distributed over the farm by a simple system of carriers, and it is used mainly for irrigation. After it goes over one plot it flows to another, and so onwards. At the lowest part of the farm a permanent plot of osiers has been planted; the intention being that this plot will serve as a filter-bed for abstracting from the sewage all offending material which is not taken out by irrigation. After percolating through the soil of this osier-bed, the clarified sewage is received in a second, or outlet culvert, which is about two miles long, and in which the fall—one foot per mile—is less than that of the river.

Under cultivated crops of all kinds at the present time, there are about 100 acres. There is one good plot or field of Italian rye-grass; one good, and one indifferent plot of mangold wurzel; and one good plot of beans. A large field of Italian rye-grass has utterly failed, and in its place grew a luxuriant crop of weeds, which would have proved an attractive feature in a botanic garden. There are other failures on which it is useless to dwell.

The land is not farmed in what could be called a skilful manner; indeed, the engineer frankly said that up to the present, farming had been a secondary object with the Commissioners.

The greater part of the uncropped land has been recently purchased. It is now being prepared for the sewage at a cost which will doubtless exceed 20*l.* an acre. I cannot help thinking that a simpler scheme would answer equally well for irrigation.

It will be understood at once that the inhabitants of Northampton have been rid of the abominable stench which the sewage formerly inflicted on them. But there remain for consideration two points of very great importance to the people who live along the river below the sewage farm. In the first place, if the sewage be not deprived of its organic impurities on the farm, it must, on mixing again with the river, cause a fresh nuisance. That the people do think so is evidenced in a newspaper report which lies before me; and judging from what I saw of the effluent water, I can sympathise with these people. I took a small bottle of this water, which I find contains a large quantity of organic matter. As it went on the osier-bed it was still sewage most unmistakeably; and when the pores of this bed—this so-called filter bed—become full of the organic impurities, as they soon must, the complaints will become louder and louder, and justly so.

I have a second objection to the arrangements here adopted, and it is this: What guarantee is there that the *contagium* of any infectious disease which may be in the sewage is destroyed? That *some* of it would be oxidised or destroyed in flowing over the ground is certain; but the necessities of the case require that the whole of it should be destroyed. I have made experiments which prove conclusively that the contagium of infectious cattle diseases is not destroyed in flowing over land, nor in passing through such a filter as is here provided; and as there is no evidence to show that the contagious principle of human infectious diseases is not equally active, it cannot be said that the Commissioners of Northampton have satisfactorily disposed of the sewage of that town.

THOMAS BALDWIN

NOTES

WE take the following from the New York *Nation* of Aug. 20:—"The American Association for the Advancement of Science has held its annual meeting at Hartford during the past and present week. The most important business before the meeting has been the consideration and adoption of a new constitution, designed to remedy a long-continued evil growing out of the popular character of the Association. The scientific character of the papers and proceedings has very frequently been such as seriously to compromise the standing of the Association in the scientific world. To remedy this, it has been decided to select from the members those who are engaged in science and form them into a separate class of 'Fellows.' All the officers of the Association are now to be chosen from this class, and the power of the several committees to exclude improper or unsuitable communications has been increased. All friends of science will await with interest the working of this improvement. The necessity of some vigorous and effective measures must be obvious to any one who will simply examine the lists of papers presented for reading. Among some hundred authors, the number of really eminent men may be counted on one's fingers, while the large majority are entirely unknown, and present papers which, so far as can be judged from their titles, are of no scientific importance. We greatly doubt whether this evil will be cured by anything short of a radical change in the publishing system of the Association. So long as there is a volume of 'Proceedings' to be published, so long will there be a pressure on the part of the less desirable class of members to have their papers printed, and this pressure can be resisted only by a little more moral courage on the part of the Standing Committee than it has hitherto exhibited. While such papers are admitted, we may be sure that few of the abler members will wish their productions to be seen in such company. It is gratifying to notice that the present meeting exhibits a decided improvement in this respect, and that notwithstanding the general unimportance of the communications, the subjects of ether and atoms do not appear among those discussed before the Association."

UNDER the Principalship of Monsignor Capel, a Catholic College is shortly to be opened in Kensington, in which the Natural Sciences will be taught without restrictions. A museum, a laboratory, and lecture rooms are in readiness; and in the Educational department more than one appointment has already been made. Mr. St. George Mivart is to lecture on zoology during the winter months, and on botany in the summer. Mr. Barff is to lecture on chemistry. From what we hear, it will not be for lack of means that this institution will not be successful.

AMONGST those who will probably be candidates for the professorship of Zoology and Comparative Anatomy, now vacant in University College, London, are Mr. E. Ray Lankester, Dr. J. Murie, and Mr. H. Seeley.

DR. ALLEYNE NICHOLSON has been appointed to the chair of Biology and Physiology about to be established in the Durham University Colleges of Medicine and Physical Science, Newcastle-on-Tyne.

ON the 3rd inst. the Bishop of Exeter laid the foundation-stone of a high-class school, to be conducted under the provisions of the Endowed Schools Act, at Newcastle-under-Lyne. His lordship dwelt chiefly on the advantages of a modern education, embracing chemistry, mineralogy, and mathematics, as compared with the old Latin and Greek system. He congratulated the borough upon doing the most important work that not only the district, but the whole of England could be engaged in, by establishing a school in which boys might not only be taught a little Latin and less Greek, but might be taught modern languages and natural science, so as to fit them for the future occupations of life.

In this connection we would refer to Sir Charles Reed's statement, on Tuesday night, at the Radnor Street Schools, City Road. "With respect to scientific education," he said, "this country is far behind other countries; and in that she has fallen back, as she has also in manufactures and in trade, and is letting such countries as America and Germany run far ahead of her. More attention must be paid in all our schools to the scientific education of children."

The Duke of Bedford has just sent 100*l.* for aiding in the establishment of the Artisans' Institute for Promoting General and Technical Knowledge, to the Rev. H. Solly, who is to be its first principal. Mr. Samuel Morley, M.P. (who is one of the trustees in conjunction with Lord Lyttelton and Mr. Hodgson Pratt), has also given 100*l.*, besides guaranteeing 100*l.* a year for three years. These, with smaller contributions from a number of other friends, have enabled the trustees to take premises in Upper St. Martin's Lane, which will be well adapted for the purpose when considerable alterations have been made in them. The object of the Institute appears to be to exemplify in a central locality, and in a special instance, those plans for the general and technical instruction of the working classes which so many of them now desire to see carried into effect, and which Mr. Solly aimed at promoting on a national scale by the formation of the "Trades Guild of Learning." Pending the satisfactory establishment and full development of the larger organisation, it is hoped that the proposed Artisans' Institute will, both directly and indirectly, give a considerable impulse to the higher as well as technical education of the skilled workmen of the metropolis, as many of their leading men have publicly signified their cordial approval of the project; and the desire for increased culture is rapidly increasing among that important and intelligent class. It is expected that the Institute will be ready to open early in October. Donations in aid of it will be thankfully received, and may be paid to the account of Mr. Hodgson Pratt, treasurer *pro tem.*, at the London and Westminster Bank, 217, Strand.

An enthusiastic meeting was held in Bombay on the 1st of August, at which a committee was appointed for the purpose of raising a fund by public subscription for a memorial to the late Dr. Bhau Dajee, of whom we gave some account in a recent number.

The Government of India, says the *Bombay Gazette*, has determined to perpetuate the memory of Dr. Stoliczka, the distinguished naturalist, who met his death on the return journey from Yarkand, by erecting, at the public expense, a tomb over his remains at Leh, and a tablet in the new Indian Museum at Calcutta.

The death is announced of Sir John Rennie, C.E., F.R.S., the eminent civil engineer, under whose direction some of the most important engineering works of the past half-century have been carried out. Sir John, who died on Thursday last at Bengeo, in Hertfordshire, was born in 1794, and was the son of the late Mr. John Rennie, who designed new London Bridge, and who also designed and executed Southwark and Waterloo Bridges. Mr. Rennie educated his son for his own profession, and left to him the task of executing his designs for London Bridge. On its completion and opening in 1831 Mr. Rennie received the honour of knighthood. Several foreign distinctions had been conferred upon him.

Our readers will be glad to hear of the safety of the members of the Austrian Payer and Weyprecht Arctic Expedition, who have been out for two years, and who, it was feared, had come to grief. A *Times* telegram, dated Christiania, Sept. 5, gives a brief history of the expedition. They left Tromsö in the *Tegethoff* on the 14th of July, 1872. They encountered compact drift ice in 48° E. long., and worked themselves through until, in 58° E. long., they reached the coast of Novaya Zemlya, under the Admiralty Peninsula: They sailed along the coast to Berch Islands, where they met Count Wiltczek's sloop *Isbjörn*. They sailed together with him further to Barents Islands, near the promontory of Cape Nassau, where they remained at anchor till the 21st of August, 1872, on account of south-westerly storms. There a depôt of provisions was established. They parted with Count Wiltczek and steered north-east the same day, and were completely frozen in. They drifted with the pack ice fourteen months, first north-east to 73° E. long., and then north-west until October 1873. In August 1873 a new land was discovered, They drifted with the ice along this land. They were frozen in. and wintered in 79° 51′ N. lat. and 59° E. long. In March and April 1874 sledge expeditions were sent north and west; 82° N. lat. was passed, and land was seen to the 83rd degree. The extent of the land northwards and westwards was, apparently, considerable. The ship, now being untenable, was abandoned. Starting on the 20th of May, 1874, with four sledge boats, they met the open water on the 15th of August, and crossed to Novaya Zemlya, and went along the coast in search of vessels. They met a Russian schooner on the 24th of August in Puchowa Bay, and arrived at Vardoe, in Norway, on the 3rd of September. The health of the crew was excellent. Engineer Krisch died in March 1874 from tuberculous disease. Large mountain ridges are said to have been observed in the newly discovered land, but no signs of animal life; and immense glaciers were met with.

The loss is announced of the whaler *Arctic*, of Dundee, at Davis's Straits. The *Arctic* at the time she was lost was full. She was commanded by Capt. Adams, with whom, it will be remembered, Capt. Markham, R.N., of the *Sultan*, made a voyage of investigation a year ago. Capt. Adams had distinguished himself by the surveys which he made of several of the Arctic coasts. All hands have been saved.

The Berlin African Exploration Society is fitting out a second expedition to the interior of Africa. Herr Alexander von Hormayer, the well-known ornithologist, will be the leader of the expedition, and will go from St. Paul de Loanda by way of Kassimbe to Moatta Jambe.

The British Bee-keepers' Association, founded in May last, has been fortunate in securing Sir John Lubbock as its President, and though the members number but little over 120, they have already shown a commendable earnestness. On Tuesday they held, at the Crystal Palace, their first show of bees, hives, honey, and accessory apparatus; and during the day some of the bee masters manipulated their hives, showing how to take honey, introduce queens, and to do other necessary work usually supposed to be accompanied with some danger. The primary object of the Association is to promote the more extensive cultivation of bees, especially by cottagers, and the study of the best way of obtaining most honey with the least waste. The American "Slinger" was shown in operation, and effectually drives out by centrifugal force all honey from a comb without injuring the By the application of this principle much of the time that would be occupied in making cells is saved, and bees at once begin refilling the comb. A secondary object of the Association is to promote the study of the habits and powers of bees, and special prizes were offered for observatory hives. Now that Sir John Lubbock has led the way in showing how to observe individual bees (see Nature, March 26), we may expect that many people will be induced to take up such an interesting subject and add to our stock of knowledge. Almost everything about the powers of bees has yet to be learned. An observatory hive stocked with bees costs, we believe, only about thirty shillings, and the *British Bee Journal* is always willing to give any information to inquirers needing instruction. The last number that has been forwarded to us, and besides giving a great deal of practical instruction, contains an interesting article on the Philosophy of Hive Shape.

THE Southport (Lancashire) Aquarium will be opened on the 16th inst.

AMONG the newly enrolled members of the Victoria Institute is M. Joachim Barrande, the Bohemian palæontologist.

A TELEGRAM from Rome of Sept. 5 announces that the eruption of Mount Etna has ceased, but that the shocks of earthquake continue.

THE *Melbourne Argus* has the following among its news from the South Sea Islands :- "On the 30th of April Captain M'Kenzie observed what he believed was a submarine volcano in a state of activity. When about midway between Haabai and Tonga, two of the Society Islands, about 12 miles from land, he observed a large column of water shoot up fully 100 feet into the air. There was a dense cloud of what appeared to be steam rising from the ejected water. Captain M'Kenzie was afraid to go sufficiently near to ascertain whether it was warm water that was ejected, but upon this point there can be little doubt. The spot where he saw the water sent up is marked on the chart as a shoal, and so long as he was in sight the water continued to be sent upwards with equal force."

THE additions to the Zoological Society's Gardens during the past week include a Toque Monkey (*Macacus pileatus*) from Ceylon, presented by Mrs. Thomas; a Macaque Monkey (*Macacus cynomolgus*) from India; a Malbrouck Monkey (*Cercopithecus cynosurus*) from West Africa, presented by Mr. H. C. Marckmann de Lichtabbell; an Arctic Fox (*Canis lagopus*) from the Arctic Circle; a Black-headed Gull (*Larus ridibundus*) European, presented by Mr. Keell; a Prairie Marmot (*Arctomys ludovicianus*) from North America, presented by Mr. Thellusson; a Guilding's Amazon (*Chrysotis guildingi*) from St. Vincent, purchased; four Houbara Bustards (*Houbaria undulata*) from Tripoli, deposited.

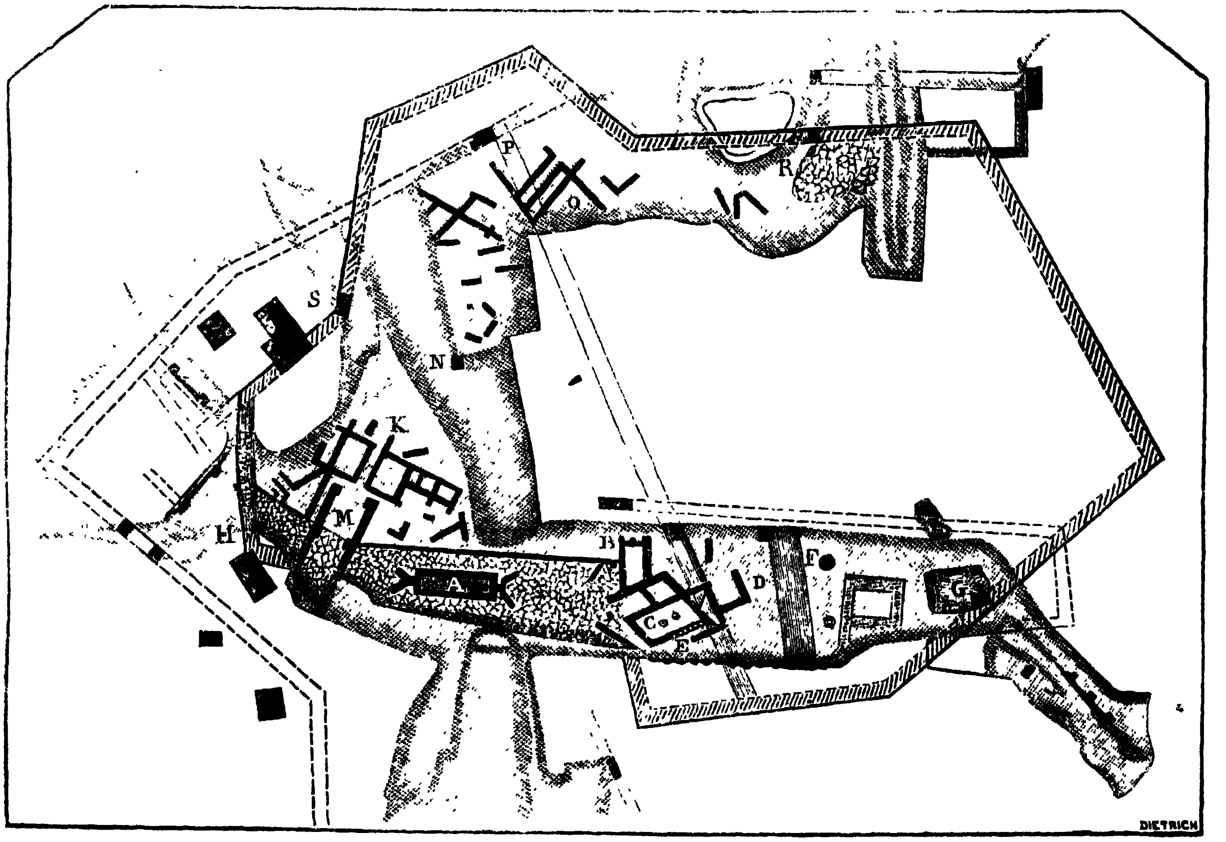

FIG. 1.—Plan of Troy in the time of Priam. A. Tower of Ilium. B House of two storeys before the taking of Troy. C. Trojan structures and later structures superposed. D. Trojan houses E. Large earthenware jars F. Altar for sacrificing to the Trojan Minerva, with drain for carrying off the blood. G. Remains of Trojan houses. H. Place where the treasure of Priam has been found. K. Remains of Priam's palace. M. Gates. N Wall prior to Troy. O. Trojan houses and later walls superposed. P. Fortified wall prior to Troy. R. Wall of defence prior to Troy. S. Remains of the *enceinte* of Troy.

THE RUINS OF TROY: RECENT DISCOVERIES OF DR. SCHLIEMANN[*]

OUR age is eminently an age of investigation, and, more than any previous one, is drawn towards archæological studies by a restless and feverish ardour. Dissatisfied with the present, it rushes back into the past, to seek for traces of the most ancient origins of man and of his races, the primitive sketches due to his artistic and industrial genius, the beginnings, still so obscure, of his history, and even of prehistoric times. The learned works of Mr. Layard on Nineveh and Khorsabad, the fruitful excavations of M. Mariette in Egypt, those of the Americans in the mounds and tumuli of the Ohio and Mississippi, the discoveries, so valuable for human palæontology, due to the courageous perseverance of Boucher de Perthes and to the ingenious sagacity of M. Lartet, of Sir Charles Lyell, of Sir John Lubbock, Prof. Wilson, Mr. E. B. Tylor, and others,—does not all this indicate a very distinct movement towards researches which have for their object the vestiges which man has left on the earth or in its depths from the most remote periods ?

To the number of the most recent archæological labours which have strongly attracted public attention, we must add, with good reason, the important and magnificent work of Dr. Heinrich Schliemann, which has just been published at Leipzig, under the title of "Trojanische Alterthümer" (Trojan Antiquities).

A poet has said, in speaking of the ancient city, whose misfortunes another poet has sung in immortal verse,—

> "Etiam periêre ruinæ."

But Dr. Schliemann and the noble companion of his life and his labours have given the lie to Lucan. Others, it is true, believed that they had discovered the ruins long ago. Towards the end of last century (1788), a French traveller, Le Chevalier, professed even to have proved that Virgil was mistaken in placing, along with all Greek antiquity, the city of Troy and its citadel on the heights indicated by Homer, the little hill which to-day bears the name of Hissarlik.[*] According to him, the Homeric city must have been built upon the site occupied by the present village of Bunarbashi; the citadel of Pergamos was situated, on the contrary, on one of the rocky hills which encloses the Scamander, and at the summit of which is seen three conical knolls, ranged in a line, which Le Chevalier regarded as the tombs of the Trojan heroes. As to the springs which flow from the foot of the hill, these were, according to the author of the "Voyage en Troade," those where the Trojan girls went to wash their clothes.

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[*] Translated from an article in *La Nature*, by Dr. N. Joly, of Toulouse.

Although based on topographic data very open to controversy and upon texts falsely interpreted, the work published in 1788 by Le Chevalier had a very great success (three editions from 1788-1802), and his opinion, thoroughly erroneous as it was, acquired, so to speak, the force of law.

Even quite recently (in 1871), this opinion found an unfortunate defender in Dr. Karl Curtius, of Berlin, and that at the very moment when the excavations of Sir John Lubbock, of Consul Hahn, and, above all, those of Dr. Schliemann, put Bunarbashi out of the question, and brought forward the most convincing proofs in favour of Hissarlik.

In fact, these excavations have demonstrated, as far as evidence can go, that neither the pretended Trojan tombs indicated by Le Chevalier, nor the site of Bunarbashi itself, contains any archaic object, any trace of human habitation. It is, then, neither at Bunarbashi, nor at Chiblak, nor at Atchi-Kienni (which is now quite given up), that we must seek for the veritable Troy and the citadel of Pergamos. Let us see if we shall be more fortunate in carrying on our investigations on the site of Hissarlik; that is to say, in allowing ourselves to be guided by popular tradition, the writings of the most ancient trustworthy authors, and chiefly by the gigantic excavations executed at so great an expense and with so much zeal and intelligence by Dr. Schliemann and his wife.

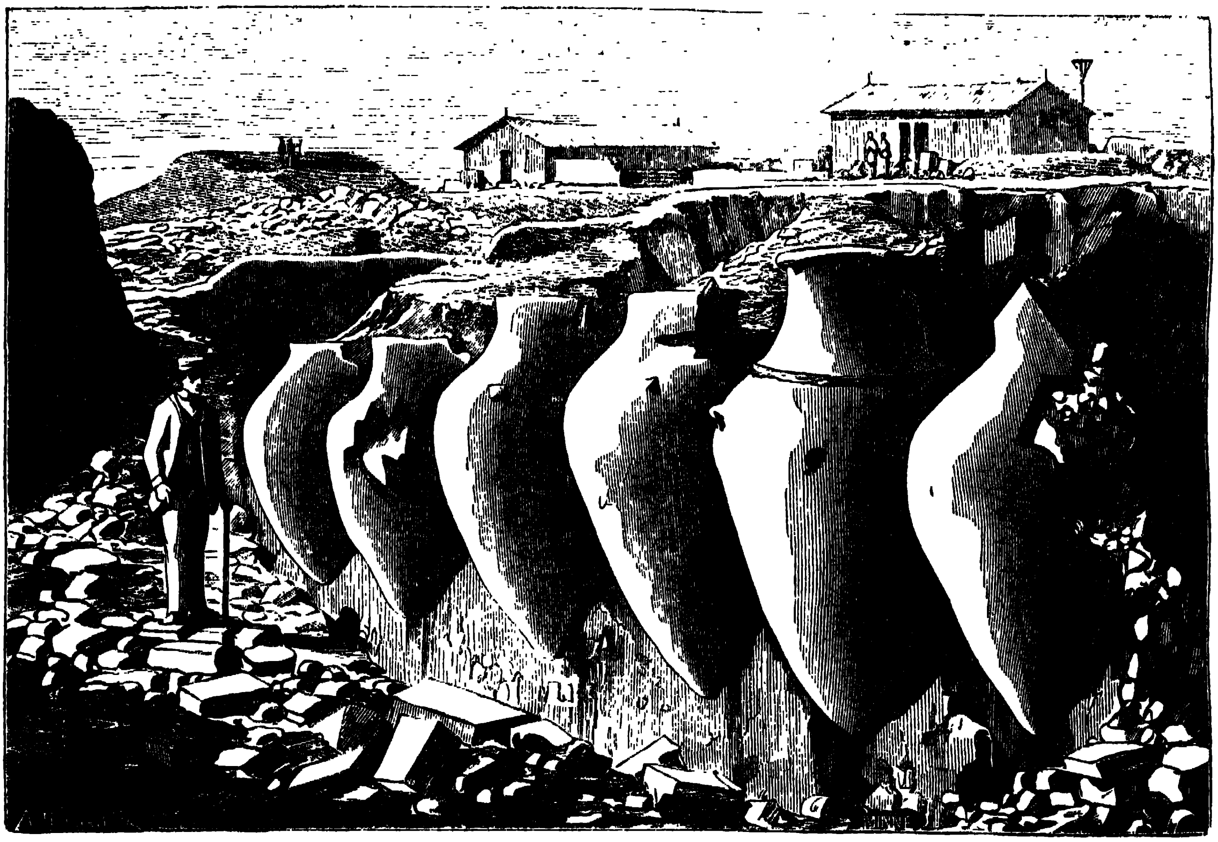

FIG. 2.—Large earthenware jars found in the ruins of Troy, at E, in Fig. 1.

Here, independently of the authority of Homer, we have still that of Herodotus, of Xenophon, of Arrian, of Plutarch, of Justin, who all agree in placing the Ilion of Homer at Hissarlik; that is, at the place where Dr. Schliemann has found ruins overlaid by many layers of more recent ruins. In one of these layers, which extends from seven to ten metres below the summit of the hill, are found, in fact, incontestable proofs of a violent fire,[†]—a palace, a double gate situated on the west of this palace, a tower rising at some distance from the double gate, religious symbols (images and vases in the shape of an owl, *γλαυκώπις Ἀθηνή*), and finally a treasure containing objects which, in their smallest details, answer to the descriptions which Homer gives us. Is there not here enough to satisfy the most sceptical and most exacting?

Begun in the month of April 1870, the excavations executed by Dr. Schliemann were only terminated in October 1873. They have thus occupied him three entire years, and that in the midst of the greatest difficulties, sometimes even at the risk of his life and that of the numerous workmen, Turks and Greeks, whom he employs in these works. I pass in silence the harassing difficulties which the Turkish Government has raised to prevent him attaining the precious results with which these excavations have enriched the science of the past.

(*To be continued.*)

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[*] For an excellent study on the topography of Troy, see an article by M. Emile Burnouf in the *Revue des Deux-Mondes* of Jan. 1, 1874.

[†] M. E. Burnouf places the fire in the seventeenth century B.C., 700 years, according to some, before the time of Homer.

THE BRITISH ASSOCIATION

REPORTS

Report of the Committee on Experiments to determine the Thermal Conductivities of certain Rocks, by Prof. Herschel and Mr. Lebour.

In the introductory notes on these experiments, published as an appendix (p. 233) in the last volume (for 1873) of the British Association Reports, the list of rocks selected and the manner of experimenting on them were described. With the exception that sections of Calton trap rock, of a great pyramid casing stone (nummulitic limestone), Caen stone (or Normandy building limestone), Cannel coal, chalk, and red brick were added to this list, and that the apparatus received some small but very important improvements to make it heat tight, the material of the experiments as well as the method of working them remained substantially the same as last year. Instead of a conical tin vessel with 1 lb. of water, a cylindrical one holding 2¼ lbs., with an internal agitator and thermometer, was used as the cooler. The opposite faces of the heater and cooler were lined with velvet and each clasped by a caoutchouc collar, which, projecting a little above them, clips the circular edge of the rock plate when it is placed between them, and two small notches cut in each collar also allow the wires of a thermocouple to be introduced, touching the rock-surfaces while the rock is being heated. With the view of traversing the plate with the thermopile in different directions, the piece of stout palladium wire (about 18 gauge) used as the electromotive element between the two iron wire branches of a delicate reflecting galvanometer, was silver-soldered to the iron wires at its two ends, all the wires being first rolled thin and flat to some distance from the junctions. The scythe or scimitar-blade shape most easily given to the wire in rolling it thin was advantageous in the construction, because, instead of uniting the wires continuously in one straight length and folding the points of junction on opposite sides of the rock (thus confining their range upon it to a single diameter or to one straight line), advantage of the curvature was taken to connect the wires by superposition, instead of by prolongation at their junctions, without overlying each other, into two flat ogee arches, or merry-thought-like blades, between which the rock is held as in a forceps. The straight unrolled parts of the wires are bound very firmly to a square piece of wood, which acts as a handle to guide the points of the forceps to various parts of the rock-faces, while it keeps them securely in their places, and thus allows the small elastic pressure of the wires to clasp the rock gently between the points of the thermo-electric pincette without assistance from the velvet covers. After thus inserting a rock section in the apparatus, protecting the rock and cooler from below with a stout wooden screen, and from loss or gain of heat in other directions by a suitably thick case of woollen stuff and a few bandages of similar materials, the rate of rise of temperature in the cooler, when agitated, was noted by the average number of seconds taken by a delicate thermometer contained in it to rise $\frac{1}{6}$° F. (one graduation on its stem) as soon as this rate of rise was found to have become sensibly constant. About twenty minutes were usually occupied in the beginning of an experiment with waiting for a steady condition of the thermometer readings, and ten or twelve minutes more were required to ensure it and to obtain the average rate of their increase for the rock specimen under observation. The temperature difference shown by the galvanometer at the same time at first rose rapidly to a high maximum and then descended very gradually to a fixed lower reading. The pincette was traversed to and fro over the rock surfaces while the thermometer was being noted, and exhibited during these motions fluctuations answering to about 1° or 2° F. on either side of an average position; corrected for zero of the scale and reduced by trials for this purpose between every two or three experiments to Fahrenheit degrees, the temperature difference thus formed, divided by the quantity of heat transmitted to the cooler per minute, gave the apparent thermal conductivity of the plate. The results in Peclet's units were scarcely more than one-third of what Peclet and other earlier experimenters had obtained. It was obvious that, instead of marking the temperature difference between the two solid contact surfaces of the rock and velvet which they touched, the points of the thermo-electric forceps showed the temperature of the fluid air-bath in which those two surfaces are immersed. The extreme mobility of this integument, enabling it to penetrate through the velvet to the plates of the heater and the cooler, while it equally insinuates itself between the rock surface and the thermopile that can only enter into actual solid contact with each other (at least theoretically) at three points, controls the temperature of the metallic thermometer far more powerfully than the rock face that it touches, and the real temperature differences between the rock faces are accordingly completely masked. It is very probable that if the velvet covers fitted on the instrument were replaced by soft wash-leather, the source of this error would be very much reduced; and although it is certain that the confronting surfaces of the rock and leather faces will nowhere have actually the same temperature, from the existence of a sensible quantity of resisting air between them, so that, as before, the thermopile will not mark the true rock temperature difference, but a mean between that difference and a similar difference for the leather faces, yet the range of this error will be incomparably smaller than in the experiments already made with velvet covers, whose loose texture precludes the possibility of regarding the comparative results now obtained as positively correct, or more than first approximations, from which the errors arising from surface characters of the rock sections tested have not yet been removed.

To obtain the true rock temperature differences, means were taken to cement the thermopile points to the rock with plaster, a course it would be desirable to adopt with as few samples as possible as standards of correction for the rest, on account of the tediousness of the process and the injury that it necessarily entails to the beautifully worked surfaces of many of the plates. If the correction so found to be required can be restricted by the mode of operating to a range of such small limits as to be applicable generally, without appreciable influence of the surface characters, in making its occasional departures from a mean value very sensible, then the reduction factor found by absolute experiments on a few rocks of characteristically rough and smooth or polished surfaces to obtain the true temperature difference for a given heat-flow from the apparent one shown by the thermocouple placed simply between the rock and leather faces will be admissible within the limits of error of the observations to convert a list of apparent conductivities as just supposed to be obtained from a mere comparative table of relative conducting powers to a table of absolute thermal conductivities, in which the errors of the values given will certainly not be greater than would in all probability have been committed had the direct method of absolute measurement been applied separately to each specimen of the list, instead of only to a few rocks, to furnish data on which calculations of the remainder may be founded. Circular discs of linen, well wetted with plaster of Paris, mixed with a little glue or white of egg, were laid over the surfaces of two or three of the rocks, enclosing under them and against the rock (to which they were also plaster-wetted) the two branches of the thermopile pincette. When these had set quite hard under pressure and were thoroughly dried by a gentle heat, they were placed in the apparatus, and a measurement of the absolute temperature difference and accompanying heat-flow was thus obtained, affording the real conductivity and a means of comparing it with the apparent one found by similar observations of the same rock when no plaster was used, and when the points of the thermopile merely pressed against its surface. Thus the thermo-electric difference obtained with the wire couples merely touching the surfaces of white statuary marble between velvet faces was 16°, while for the same heat-flow when the arms of the thermopile were firmly plastered to the marble plate, the temperature difference observed was only 16°·2 [*]—being more than 2½ times as large a difference in the former as in the latter case. With whinstone the corresponding temperature differences were 26° and 8°·5.—in the proportion of very nearly 3 : 1. A similar experiment was made with cannel coal, of which the conductivity is much less than that of the last-mentioned rocks, the temperature differences obtained being for the same heat-flow in the plain and plastered plate 53°·4 and 39°·7; in the proportion of only 1·37 : 1—a far smaller reduction than was observed in the two foregoing cases. Care is, however, necessary to introduce wet plaster under as well as over the points of the thermopile in cementing them to the rock, that air may be excluded and the junction may be solid, a precaution which was omitted in this case, as plaster without size was used, which in drying sometimes flakes off from the rock surface either entirely or in places. This may render an experiment, as that on cannel coal may not impossibly have been, from this cause entirely valueless; yet this result presents itself, with many others met with in the investigation, as very well worth repetition, with fresh precautions and with new arrangements to guard against the possibility of false conclusions.

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[*] The heat-flow through the plate was actually greater in this latter than in the former case in the proportion of about 5 : 4, showing that the rough plaster-washed linen surface received and delivered heat to the velvet covers much more readily than the smoothly-dressed surface of the stone, and the whole resistance was less in the latter than in the former case, although the rock plate itself had been made thicker. The same diminution of the total resistance occurred also in the experiment with plastered whinstone.

Adopting for the present, as probably not very far from the truth, a common reduction factor of 2⅔ as the proportion in which the recorded temperature differences of the plain rock surfaces between velvet faces exceeded the true temperature differences of the surfaces of the rocks examined, and introducing some very small corrections for the thicknesses of the plates, the thermal capacity of the metal cooler, &c., which are all probably (as well as the allowance for heat-absorption in raising the temperature of the rock plates very slowly during the observations) really negligible in comparison with the uncertainty that attaches (except in one or two well-observed cases of absolutely measured temperature differences of the rock faces) to the great majority of the determinations from unknown peculiarities of surface contact and temperature assimilation where air is not excluded from the junctions, or rendered stagnant in its mode of heat transmission, the following table gives the absolute thermal conductivities (in centimetre-gramme-second, or absolute British Association units) thus provisionally obtained, together with a few similar results found by Peclet, Forbes, and Sir William Thomson in rocks differing little in their description from those included in the present list.

Provisional Determinations of Thermal Conductivities of certain Rocks.—First Experimental Results.

Description of Rock.	Thermal conductivity (gramme-water-degree heat units per second) at 1° difference of the faces, through a centimetre cube.	Earlier Observations of Conductivities of similar Rocks.		
			Description of Rock.	Observers.
Grey Aberdeen granite...	·00600			
Red Cornish serpentine	·00483			
Calton trap rock (first specimen)... ...	·00520	·00266	Calton trap rock	Forbes and Thomson.
Whinstone	·00312	·00169	Sand of experimental rock, Thermometer garden	
Kenton sandstone	·00489	·00689	Cragleith sandstone	
Congleton "second grit" stone	·00462			
Slate	·00392			
Alabaster	·00412			
Sicilian white statuary marble	·00559	·0097	Fine-grained grey marble...	Peclet.
Irish fossil ditto	·00559	·0077	Coarse crystalline white ditto	
Devonshire red ditto	·00525	·0058	Fine-grained calcareous stone.	
Italian vein marble (white, grey veins)	·00512	·0047	" " "	
Irish green marble	·00507			
Nummulitic limestone (a piece of Great Pyramid casing-stone)	·00433			
Caen (building) limestone	·00395	·0037 ·0035	Coarse-grained lias building stone	Peclet.
Chalk...	·00384			
Black shale (Newcastle-on-Tyne) ...	·00178			
Cannel coal	·00161			
Plaster of Paris (for castings)	·00163	·00145 ·00122	Ordinary fine plaster (made up) ... ... Finest ditto for casting (made up)	Peclet.

The Report of the Committee for superintending the monthly reports of the progress of Chemistry, by Profs. Roscoe and Williamson, was then read by Prof. Roscoe. The report was very short; the committee does not intend to apply to the British Association for a further grant after the present year.

Report of the Committee on Essential Oils, by W. Chandler Roberts.—The following oils have been examined: Wormwood, Citronella, and Cajeput. The actions of phosphorus pentasulphide, of zinc chloride, and of bromine upon the oils were described. The first-named reagent generally acts by removing the elements of water, with formation of terpenes and cymenes. Zinc chloride generally causes decomposition, giving rise to a mixture of hydrocarbons. Bromine usually forms a bromide, which is then decomposed with evolution of hydrobromic acid and water and formation of a cymene.

Various cymenes have been examined, all of which seemed to be the same. The formation of cymenes from terpenes by the action of sulphuric acid has been verified. Cymenes have also been obtained from oil of turpentine by continued fractionation.

The following numbers express the optical properties of some of these oils:—

	Specific refractive energy.	Specific dispersion.
Absinthol	·4887	·0234
Cajeput	·4916	·0251
Citronella	·5213	·0289
Citronellol	·5176	·0284

The conclusion drawn is, that cymene is the central body in these essential oils, to which the other constituents are closely related; the varying amounts of mechanical energy required for the formation of the different isomerides have not as yet been determined.

Dr. Gladstone said that the optical properties of sixteen cymenes had been examined. Some of these were obtained from substances of low, others from substances of high refractive energy, but in all cases the refraction of the cymene was the same; the refraction of a substance depends, therefore, on the constitution of the substance itself.

Report of the Committee on the Estimation of High Temperatures, by J. Dewar, F.R.S.E.—The committee has not carried on any investigations during the past year.

Gold Assays, by W. Chandler Roberts.—Little has been done by the committee during the past year, but they hope to be able to report fully at the next meeting.

Report of the Committee for assisting in the Exploration of the Victoria Cave, Settle, by R. H. Tiddeman, secretary to the committee.

The explorations have been continued throughout the chief part of the year. The Settle Committee have raised by private subscriptions and spent, besides the British Association grant of 50*l.*, a sum of 113*l.* 4*s.* 3*d.* The late determination of a bone which had been found by the committee in the cave in May 1872 as human, by so great an authority as Prof. Busk, induced the committee to pay their chief attention to the question of its position and the relation of the beds in which it occurred to the physical changes to which the district has been from time to time subjected. In order to do this it was necessary to remove a large portion of the tip of the older workings, which had unfortunately accumulated below the entrance of the cave. Beneath this the Romano-Celtic layer was reached, and several objects of bronze, including bracelets, a vinaigrette, and other articles, were obtained. The Romano-Celtic layer was from 1 ft. to 1 ft. 6 in. thick; beneath this was a thickness of 19 ft. of screes, consisting of angular fragments of limestone, which had fallen from the face of the cliff above. This contained no bones whatever, nor the smallest fragment of any rock but the white limestone of which the cliff above is made. But at the base of this a great many boulders were discovered of all dimensions up to 7 ft. in diameter. The number of these boulders and the peculiar conditions of their position render it quite impossible that they can have been brought through any fissure in the roof of the cave, and so washed in later times over the beds containing the human fibula and the remains of the older mammals. The great weight of some of them quite militates against this idea. Another suggestion, that they may not have been left in their present position at the melting of the ice-sheet, but may have fallen from the cliff in comparatively recent times, is also negatived by the complete absence of any evidence of any such fall through the long period represented by the 19 ft. of screes, their occurrence only at the base of the screes, and by the absence of any drift from the cliff above for some distance round. But another strong argument against this supposition lies in the fact that the boulders are so close beneath the cliff, that if all the limestone weathered from the cliff above and now resting on the boulders were restored to the cliff it would project so much further forward that it would be impossible for them to fall into their present position; yet we know from their position that the boulders were dropped there before any portion of the screes had accumulated, and therefore at a time when the roof of the cave undoubtedly reached much further forward.

The inevitable conclusion is that man lived in Yorkshire with *Elephas antiquus*, *Rhinoceros tichorinus*, *Ursus priscus* and *spelæus*, *Hyæna*, *Bison*, and red deer long before the existence of the great ice-sheet in Northern Britain and Ireland.

Report of the Boulder Committee.

The Rev. W. H. Crosskey read the report of this committee appointed for the purpose of recording the position, height above the sea, lithological characters, size, and origin of the more important erratic blocks, and groups of erratic blocks, of England and Wales, and reporting other matters of interest connected with them. A schedule has been issued by the committee containing detailed questions of the information required. The object of the committee is not speculative, but to collect the facts, with the intention of afterwards proceeding to their classification, and pointing out their relations to the various theories under designation in glacial geology. Districts in which boulders are rarest are of special importance. The evidence regarding the southward extension of the ice sheet and the reach of the waters of the glacial sea depends largely upon their presence and absence; while their method of distribution is full of geological meaning. The necessity for the work of the committee is increased by the fact that all over England and Wales the destruction of boulders is rapidly proceeding. In the midland districts, a map is being constructed in which the approximate number of boulders and the character of the rocks of which they are formed, together with the effect of the configuration of the country on their distribution, will be shown. From the general position of the boulders it is evident that boulders were deposited at several ages. There are (1) boulders of the earliest ice periods, (2) boulders of the period of submergence, distributed in the lower parts of the glacial clays, (3) boulders of the period of the re-elevation of the land. These varieties have yet to be traced to their various sources, and upon this work members of the committee are engaged. It is as impossible to assign all the boulders to one epoch of distribution, as it is to relegate all glacial sands, clays, and gravels to one period. The report contains details regarding boulders of various districts. From Leicestershire, one fact of especial importance is recorded. Below the drift clay and quite distinct from the surface boulders freely scattered over the country, a group of boulders has been exposed in an excavation made in the centre of Leicester, 25 ft. deep, composed of rocks of foreign origin, and suggesting a stranded iceberg of an early period. In the same county, isolated boulders of large size, and groups traceable to sources some miles distant, prove Charnwood Forest to have been a centre of ice-action of considerable intensity. In Warwickshire a great change occurs. The drift-beds are reduced almost to pebbles; and local geologists give the name of boulders to specimens which in other parts would not be regarded as worthy of the name. Striations are faint and rare. Their grouping is remarkable, and they come from all points of the compass. Isolated boulders are recorded from Northumberland, Yorkshire, Lancashire, Devonshire, and Denbighshire. The committee request members of the Association who have received schedules to return them, and desire communications from geologists disposed to assist them in their work.

The Close Time Committee.

A report was read from the Close Time Committee with reference to the desirableness of establishing a close time for the preservation of indigenous animals. After stating the steps which had been taken with reference to this subject in Parliament, the committee stated its belief that the effect of birds' nesting on such kinds of birds as are known to be diminishing is altogether inappreciable, while its effect on those whose numbers are not decreasing may be safely disregarded, and consequently that there is no need of any legislative interference with the practice. The committee believed that the only practicable mode of checking the diminution of such birds as have been proved to be decreasing is the effectual protection of the adults from destruction during the breeding season. While the Sea Birds Preservation Act continued to work successfully, the Wild Birds Protection Act had done little, if anything, towards attaining the objects for which it was passed, and in various quarters gave considerable discontent. Birds commonly known as "wild fowl" were subjected to very great persecution through the inadequacy of the present law to protect them; they were rapidly reducing in number; they were not only innocuous, but were of great value as food. Consequently the committee hoped that the efforts they intended to make on behalf of wild fowl in the next session of Parliament would obtain a general support. Representations as to the inordinate slaughter of seals which took place every spring in the North Atlantic Ocean had been made to some members of the committee. There could be no doubt that such slaughter at that season would soon bring these animals to the verge of extermination, as had been the case in many other parts of the world, and since their destruction would affect a very large trade, their proper protection seemed to be a subject not at all unworthy of the consideration of the Government. The committee requested their reappointment.

SECTIONAL PROCEEDINGS

SECTION A—MATHEMATICS

On the Perturbations of the Compass produced by the rolling of the Ship, by Sir William Thomson.

The heeling error which has been investigated by Airy and Archibald Smith is the deviation of a compass produced by a "steady heel" (as a constant inclination of the ship round a longitudinal axis, approximately horizontal is called). It depends on a horizontal component of the ship's magnetic force, introduced by the inclination; which compounded with the horizontal component existing when the ship is upright, gives the altered horizontal component when the ship is inclined. Regarding only the error of direction and disregarding the change of the intensity of the directing force, we may define the heeling error as the angle between the directions, for the ship upright and for the ship inclined, of the resultant of the horizontal magnetic forces of earth and ship at the position of the compass. These suppositions would be rigorously realised with the compass supported on a point in the ordinary manner if the bearing point were carried by the ship uniformly in a straight line. They are nearly enough realised in a large ship to render inconsiderable the errors due to want of perfect uniformity of the motion of the bearing point if this point is placed anywhere in the "axis of rolling,"* for in a large ship the compass, however placed, is not considerably disturbed by pitching, or by the inequalities of the translatory motion caused by waves.

Hence, supposing the compass placed in the axis of rolling, the perturbation produced in it by the rolling will be solely that due to the variation of the horizontal component of the ship's magnetic force. Such a position of the compass would have one great advantage—that the application of proper magnetic correctors adjusted by trial to do away with the rolling error would perfectly correct the heeling error. To set off against this advantage there are two practical disadvantages: one that the axis of rolling (being always below deck) would not be a convenient position for the ordinary modes of using the compass; the other, far more serious, that in ships, at all events with iron decks, the magnetic disturbance produced by the iron of the ship would probably be so much greater at any point of the axis of rolling than at suitably chosen positions above deck as to more than counterbalance the grand kinetic advantage of the axial position. But careful trials in ships of various classes ought to be made, and it *may* be found that in some cases the compass may with preponderating advantage be placed at the axis of rolling. Hitherto, however, this position for the compass has not been used in ships of any class, and, as we have seen, it is not probable that it can ever be generally adopted for ships of all classes. It is therefore an interesting and important practical problem to determine the perturbations of the compass produced by oscillations or other non-uniform motions of the bearing point.

The general kinetic problem of the compass is to determine the position at any instant of a rigid body, consisting of the needles, framework, and fly card, which for brevity will be called simply the compass, moveable on a bearing point, when this point moves with any given motion. Let the bearing point experience at any instant a given acceleration, a, in any given direction. Let w be the mass (or weight) of the compass, and $g w$ the force of gravity upon it, reckoned in kinetic units. The position of kinetic equilibrium of the compass at that instant is the position in which it would rest under the magnetic forces and a force of *apparent gravity* equal to the resultant of gw and a force aw in the direction opposite to that of a. Now the weight of the compass is so great, and its centre of gravity so low, that the level of the card is scarcely affected sensibly by the greatest magnetic couple experienced by the needles.* Hence, in kinetic equilibrium the plane of the compass card is sensibly perpendicular to the direction of the "apparent gravity" defined above; and the magnetic axis of the needles is the direction of the resultant of the components in this plane of the magnetic forces of earth and ship. Hence it is simply through the *apparent level* at the place in the ship occupied by the compass differing from the true gravitation level that the problem of the kinetic equilibrium position of the compass in a rolling ship differs from the problem of the heeling error referred to above. That we may see the essential peculiarities of our present problem, let there be no magnetic force of the ship herself or cargo. The kinetic equilibrium position of the magnetic axis of the compass will be simply the line of the component of terrestrial magnetic force in the plane of the apparent level. The author then investigates, by a mathematical process, an expression for "the kinetic equilibrium error," which is so named in order to distinguish it from the error actually exhibited by the compass. The kinetic equilibrium error is exactly the error which would be shown by an ideal compass with infinitely short period of vibration. A light quick needle (either with silk fibre suspension or supported on a point in the ordinary way), having a period of not more than about two seconds, shows the rolling error very beautifully, taking at every instant almost exactly the position of kinetic equilibrium. Sir W. Thomson has thus found it so great in a small wooden sailing vessel that it became very difficult to make exact observations with the quick compass, either in the Firth of Clyde or out at sea on the Atlantic, unless when the sea was exceptionally smooth. The kinetic theory of forced oscillations is readily applied to calculate, whether for a wooden or an iron ship, the actual "rolling error" of the compass from the "kinetic equilibrium error," but the author remarks that it would extend the present communication too far to enter on details of this solution. For the present it is enough to say that no admissible degree of viscous resistance can make the rolling error small enough for practical convenience, unless also the period of the compass is longer than that of any considerable rolling to which the ship may be subjected. Probably a period of from fifteen to twenty seconds (such as an ordinary compass has) may be found necessary for general use at sea; and it becomes an important practical question how this is best to be obtained, consistently with the smallness of the compass needles necessary for a thoroughly satisfactory application of the system of magnetic correctors, by which the Astronomer Royal proposed to cause the compass on an iron ship to point correct magnetic courses on all points.

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* One way, probably the best in practice, of finding by observation the position of the axis of rolling is to hang pendulums from points at different levels in the plane through the heel perpendicular to the deck, till one is found which indicates the same degrees of rolling as those found geometrically by observing a graduated scale (or "batten") seen against the horizon.

On the Spectrum of Coggia's Comet, by Dr. Huggins.—The new point noticed in this communication was that the bands of the comet were so far shifted as to indicate—supposing there really was carbon in the comet—that the relative motion of the approach of the comet to the earth was forty-six miles per second. The comet really, however, approached the earth at the rate of twenty-four miles per second; and it was therefore uncertain whether the whole or part of the difference in this velocity was due to the motion of matter within the comet. The brighter portion of the head of the comet was due evidently to a larger proportion of the matter giving a continuous spectrum. It seemed probable, therefore, to the author that the nucleus was solid, heated by the sun and throwing out matter which formed the coma and tail; and part of this was in a gaseous form, giving the spectra of bright lines. The other portion existed probably in small incandescent particles; the polariscope showing that certainly not more than one-fifth of the whole light was reflected solar light.

Further Experiments on Light with circularly ruled plates of glass, by Philip Braham, F.C.S.

Interposing plates of circularly ruled glass in the beam of light from a heliostat, the rings of colour are in the same order by reflection and refraction, the red in both cases being outward.

Observing the rings of reflected colour when the unruled surface of the glass is away from the heliostat, dark bands make their appearance concentric with the coloured rings, if the surface of the rulings is at right angles to the direction of the beam, and on altering the angle of the ruled plate the dark bands expand until they intersect the coloured circles, and also appear considerably beyond them.

Placing a polished plate of speculum metal in contact with the ruled surface of the glass increases the intensity of the dark bands, and by adjustment shows that according to the distance of the reflecting surface from the ruled, the number and thickness of the dark bands are increased or diminished.

A description was given of the heliostat used, the reflector being a rectangular glass prism.

SECTION B—CHEMICAL SCIENCE

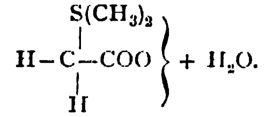
The Chemical Composition of Jute Fibre, by Prof. Hodges.—The jute plant belongs to the family Tiliaceæ. The *Corchorus capsularis* and *C. olitorius* are both cultivated.

The structure of the fibre is different from that of other textile fibres, the central space being very irregular, varying from the thickness of a line to a considerable width.

By the action of aniline sulphate, jute fibre becomes of a golden yellow colour, whereby it is distinguished from hemp and flax. The following is the analysis of jute fibre:—

Wax and fatty matter soluble in ether	0·235
Tannic acid and colouring matter soluble in alcohol	1·135
Sugar, pectine, &c.	2·427
Soluble nitrogenised matters	0·512
Insoluble ,, ,, ...	2·433
Inorganic matter combined with fibre	1·010
Cellular fibre	92·248
	100·000
Nitrogen in original fibre	0·291
Nitrogen in fibre after treatment with solvents ...	0·210

Methyl-thetine, by Prof. Crum Brown and Dr. E. A. Letts.—By the action of bromacetic acid on methyl-sulphide, methyl-thetine hydrobromate is produced. By the action of moist silver oxide on this hydrobromate, silver bromide is found, and by the further cautious addition of the hydrobromate, the silver remaining in solution is removed. By evaporation, crystals of the base methyl-thetine are formed with one molecule of water. This crystallised base might be represented by the structural formula:—



$$\left.\begin{array}{c} \mathrm{S(CH_3)_2} \\ | \\ \mathrm{H-C-COO} \\ | \\ \mathrm{H} \end{array}\right\} + \mathrm{H_2O}.$$

By the decomposition of the sulphate of methyl-thetine by means of barium carbonate, the base may also be prepared.

This substance, methyl-thetine, has both a basic and an acid character; with hydrochloric acid it forms a hydrochloride, from which the double platinum chloride has been prepared. A double lead compound containing $2PbBr_2$ has also been prepared.

The action of iodacetic acid on methyl-sulphide does not give rise to the formation of methyl-thetine hydriodate, as might have been expected; but various substances are formed, among which is trimethyl-sulphine iodide.

Experiments on High Pressures, by Dr. Andrews, F.R.S.—The author entered into full details of the methods of preparing and using his well-known tubes for the production of high pressures. If a mixture of nitrogen and carbonic acid be subjected to high pressures (to 290 atmospheres), no trace of liquid is produced.

On the Latent Heat of Liquefied Gases, by J. Dewar, F.R.S.E.—The author has deduced a formula for calculating the latent heat of a gas from the known tension of that gas. The results of this investigation have already been communicated to Section A.

On Spontaneous Generation from a Chemical Point of View, by Dr. Debus, F.R.S.—To the question, "Has Nature ever produced organic substances from strictly inorganic materials?" Chemistry (according to the author) answers, "No!"

On the Estimation of Phosphoric Acid in Pyrophosphate of Magnesia, by Mr. Ogilvie.—The author's experiments lead him to conclude that this process cannot be relied upon unless taken in conjunction with some other, such as the Molybdate process. The influence of a great excess of magnesia, of ammonic oxalate, of citric acid, and of alumina or iron oxide, introduces sources of error.

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* Generally no adjusting counterpoise for the compass is required when a ship goes from extreme north to extreme south magnetic latitudes.

On an Improved Form of Filter Pump, by W. Jesse Lovett.—This pump, which is very simple and appears to give good results, has already been described in the *Chemical News*.

On Sulphur-Urea, by Prof. Emerson Reynolds.—By heating dry ammonium sulphocyanate, sulphur-urea—as has been before shown by the author—is obtained. If the heat be maintained at 170°, about 26 per cent. of urea is obtained in one hour. By the action of metallic oxides in solution on sulphur-urea, metallic sulphides are obtained, together with cyanamide, which, by the prolonged action of water, is changed into dicyanamide.

On the Joint Action of Carbonic Acid and Cyanogen on Oxide of Iron, and on Metallic Iron, by Lowthian Bell, F.R.S.—The author shows that a mixture of carbonic acid (CO_2) and cyanogen exercises a powerful reducing action at a high temperature upon ferric oxide. With one volume of cyanogen and six volumes of carbonic acid at a temperature of 685° to 710° F., 79·9 per cent. of the oxygen existing in combination with iron was removed, 56·3 per cent. of metallic iron being produced; by increasing the proportion of carbonic acid to fifteen volumes, 6·5 per cent. of metallic iron was produced, while ·9 per cent. only was formed when the carbonic acid amounted to thirty volumes. A certain amount of carbon is simultaneously deposited in the reduced iron. The reducing and carbon depositing power of a mixture of cyanogen and carbonic acid is greater than that of a mixture of carbon monoxide and carbonic acid.

Electrolytic Experiments on Metallic Chlorides, by Dr. Gladstone, F.R.S., and Mr. Tribe.—The authors show that if plates of copper and platinum be immersed in a dilute solution of cupric chloride, a current is obtained from the copper to the platinum, the cupric chloride is broken up into cuprous chloride and chlorine, the former being deposited on the platinum, while the latter combines with some of the copper to form a new cupric chloride $Cu + CuCl_2 = 2\,(CuCl)$. By applying an external current the same action takes place; if, however, the strength of the current be increased, the free chlorine makes its appearance. By substituting zinc for copper a greater effect is obtained; with magnesium in the place of zinc, the effect is still greater. Analogously to the foregoing, a current may be obtained by acting on a solution of mercuric chloride with gold and mercury, whereby mercurous chloride is deposited on the gold.

Composition of certain kinds of Food, by W. J. Cooper.—The author drew attention to the nourishing properties of farinaceous foods, such as arrowroot, corn flour, &c. Such foods he believes very well suited for infants and invalids. He holds that we generally take too much nitrogenous substance in our dietaries.

SECTION C—GEOLOGY

Prof. Harkness, at the request of the Committee of the Section, described briefly the geological features of the North of Ireland. The relations of the Silurian rocks to the Lower Silurians of Sutherlandshire and Cumberland were discussed, and the later formations were noticed in succession.

Prof. H. A. Nicholson exhibited and described a silicified chip of wood from the Rocky Mountains. At the Brighton meeting the same specimen was shown, when the opinion was expressed that its wood-like appearance was due to mineral structure. The chip was then regarded by some members of the Section as a hornblendic mineral, known as "rock-wood." Subsequent examination has shown conclusively that the specimen is undoubtedly true silicified wood. The age of the chip and the circumstances of its production present many points of interest. The author considers it a prehistoric relic, produced by an axe, which was probably formed out of the native copper so frequent in various paris of North America.

Prof. Harkness accepted the views of the author, and withdrew his previous opinion that the specimen was merely a hornblendic mineral.

SECTION D—BIOLOGY

DEPARTMENT OF ZOOLOGY AND BOTANY

Mr. Gwyn Jeffreys read a paper *On additions to British Mollusca, and notices of rare species from the deep water off the western coast of Ireland.* As many as forty-seven species of molluscs new to science have been yielded as the results of the dredgings in the *Porcupine*, eighty-four new to the British Isles, and 124 new to Ireland, in addition to a number of other species hitherto considered to exist only in the fossil condition, some of them as low down as the Crag. Dr. Carpenter called attention to the enormous importance of these dredging expeditions, not so much from the number of new species discovered by them as from the light which they seem likely to shed on the question of the continuity of forms of life from one geological age to another. The dredgings off Ushant at a depth of nearly three miles have been especially prolific of results. Dr. Carpenter held out some hopes that the Government might be induced to undertake the expense of a dredging expedition in our own deep seas.

Mr. P. L. Sclater read a paper *On the distribution of the species of Cassowaries.* Until very recently there was supposed to be only one species of *Casuarius*; now at least seven species are known, each with a distinct and very limited area, the genus being entirely confined to Northern Australia, New Guinea, and the adjacent isles. A full exploration of New Guinea would probably lead to the discovery of a large number of most interesting new species.

On the cause of the potato disease and the means of its prevention, by Mr. J. Torbitt. The idea thrown out in the paper was that the disease is owing to the gradual natural decay of particular varieties which never have more than a limited length of life in a thoroughly healthy condition, a view which was combated by most of the gentlemen who took part in the discussion. Mr. Carruthers described the mode in which the spores of the *Peronospora* germinate in enormous numbers on the surface of the potato plant, the germinating filaments, however, only developing to a very limited extent and dying away unless abundantly supplied with moisture. It is only by this means that they are enabled to penetrate into the internal tissues through the stomates. Prof. Du Barry's recent researches seem to point to the possibility that we have in the *Peronospora* an instance of "alternation of generations," one generation only being at present known, the other generation possibly presenting an altogether different appearance, and germinating upon some totally different plant.

Prof. Macalister read *Notes on the specimen of Selache maximus lately caught at Innisboffin.*

Further Researches on Eozoön canadense, by Dr. Carpenter. After an historical account of the controversy respecting this organism, the author proceeded to give additional reasons, the results of recent investigations, for concluding the organic nature of the organism, in opposition to the views entertained by Profs. King and Rowney, of Galway. He took the opportunity of contradicting the assertion made by those gentlemen that Prof. Max Schultze had just before his death stated his conversion to their views. Mr. Gwyn Jeffreys, Prof. Macalister, and Prof. Percival Wright expressed their general concurrence in Dr. Carpenter's views.

SECTION G

MECHANICAL SCIENCE

OPENING ADDRESS BY THE PRESIDENT, PROF. JAMES THOMPSON, LL.D.

FOR a number of years past it has been customary in this andf other sections of the British Association for the Advancement os Science, that the president should give an introductory addrest at the opening of each new session. In compliance with than usage, I propose now to offer to you a few brief remarks oe various subjects of mechanical science and practice. These subjects have not been chosen on any systematic plan. I have not aimed at bringing under review the whole or any large number of the most important subjects at present worthy of special notice in engineering or in mechanics generally. I intend merely to speak of a few matters which have happened to come under my notice, or have engaged my attention, and which appear to me to be interesting through their novelty or through their important progress in recent times, or to merit attention as subjects in which amendment and future progress are to be desired.

In railway engineering, one of the most important topics for consideration, as it appears to me, is that which relates to the abatement of dangers in the conducting of the traffic. The traffic of many of our old railways has become enormously increased in recent years. With the construction of new lines the numbers of junctions, stations, and sidings have been greatly in creased; and each of these entails some attendant dangers. As a natural consequence of the increased traffic on old railways, the additional traffic on new lines, and the increased complexity of the railway system as a whole, there have been during recent years more numerous accidents than in the earlier times of railways. It is to be recollected, however, that with a greater number of people travelling daily, more numerous accidents might be expected, and that their increased frequency, on the whole, does not necessarily indicate increased danger to the individual traveller. Referring to the statistics of railway accidents published by the Board of Trade in Capt. Tyler's Report for the year 1873, I find, for various periods during the last twenty-seven years, throughout the United Kingdom, the proportion of passengers killed from all causes beyond their own control, to the number of passengers carried, to have been, in round numbers:—

Proportion of number killed to number carried

in the three years 1847, 1848, and 1849,	1 in 4,782,000
In the four years, 1856, 57, 58, and 59 .	1 in 8,708,000
In the four years, 1866, 67, 68, and 69 .	1 in 12,941,000
In the three years, 1870, 71, and 72 . .	1 in 11,124,000
And in the single year 1873	1 in 11,381,000

It is thus gratifying to observe, that in spite of the increased risks naturally tending to arise through the increased and more crowded traffic and the more complicated connections of lines, the danger to the individual traveller is now less than half what it was 26 years ago; at least this result is indicated, in so far as we can judge, from the statistics of deaths of passengers from causes beyond their own control. That the conducting of the traffic of railways still involves hazards far from inconsiderable, and that we have much to wish for towards abatement of dangers of numerous kinds, is proved by the fact that during the single year 1873 there have been killed of the officers and servants of the railway companies in the United Kingdom, 1 out of every 323: so that, at this rate, extended through a period of, for example, 20 years' service, there would be 1 out of every 16 of the officers and servants killed.

These deaths of officers and servants are not to be supposed to be caused in any large proportion by collisions, and by other accidents to trains in rapid motion. The great majority of them arise in shunting and other operations at stations and along the lines, and occur in numerous ways not beyond the control of the individuals themselves. In respect to the passengers, too, it ought to be known and distinctly recollected, that although collisions and other violent accidents to trains in rapid motion, together with other accidents beyond the control of the individuals, usually cause by far the deepest impression on the public mind; yet the numbers of these fatal accidents are small in comparison with others arising to passengers from causes more or less within their own control. For instance, it may be noticed that in last year, the year 1873, while the deaths of passengers arising from all causes beyond their own control, in the United Kingdom, were only 40 in number, there were four times as many killed, namely 160, in other ways; and of these there were as many as 62 killed in the simple way of their falling between carriages and platforms.

In respect to the conducting of the traffic of the trains in motion, it appears to me, on the whole, that when we consider the vast complexity of the operations involved in working many of our ramified and crowded railways, and when we consider the indefinitely numerous things which must individually be in proper order for their duty, and must be properly worked in due harmony by men far away from one another, some stationed on the land, and others rushing along on the engines or trains, the wonder is, not that we should have numerous accidents, but that accidents should not be of far more frequent occurrence. There can be no doubt, however, but that of the accidents which do occur, many arise from causes of kinds more or less preventible according to the greater or less degree in which due precautions may be adopted.

Gradually, during a period of 20 or 30 years past, a very fine system of watching, signalling, and otherwise arranging for the safety of trains, has been contrived and very generally introduced along our principal lines of railway. In saying this, I allude chiefly to the block system of working railways, with the aid of telegraphic signals and interlocking mechanisms for the working of the points and signals.

In former times it was customary to allow a certain number of minutes to elapse after a train passed any station, or junction, or level crossing, or other point where a servant of the company was stationed, before the succeeding train was allowed to pass the same place. Thus, at numerous points along the line a time interval was preserved between successive trains. It was quite possible, however, that the foremost of the two trains, after passing any of these places where signals were given, might become disabled, or might otherwise be made to go slowly, and that the following train might overtake it, and come into violent collision with it from behind. In order to provide against the occurrence of such accidents, a system was introduced called the *Block System*; and its main principle consists in dividing the line into suitable lengths, each of which is called a *block section*, and allowing no engine or train to enter a block section until the previous engine or train has quitted that portion of the line. In this way a space interval of at least the length of a block section is preserved between the two trains at the moment of the later train's passing each place for signalling, and the risk of this space interval becoming dangerously small by negligence or other accidental circumstances, as the later train approaches the next place for signalling, is almost entirely avoided.

Further, at each signalling station, the various levers or handles for working the points, and those for working the semaphore signals for guiding the engine-drivers, instead of being, as was formerly the case, scattered about in various situations adjacent to the signalling station, and worked often, some by one man and some by another, without sufficient mutual understanding and without due harmony of action, are now usually all brought together into one apartment called the signal cabin. This cabin, like a watch-tower, is usually elevated considerably above the ground, and is formed with ample windows or glass sides, so as to afford good views of the railway to the man who works the levers for the semaphores and points, and who transmits, by electricity, signals to the next cabins on both sides of his own, and, when necessary, to other stations along the line of railway.

The interlocking of the mechanisms for working the points and for working the semaphores which, by the signals they show, control the engine-drivers, consists in having the levers by which the pointsman works these points and signals, so connected that the man in charge cannot, or scarcely can, put one into a position that would endanger a train, without his having previously the necessary danger signal or signals standing so as to warn the engine-driver against approaching too near to the place of danger.

The latest important step in the development and application of the block system is one which has just now been made in Scotland, on the Caledonian Railway. Before explaining its principle, I have first to mention that a semaphore arm raised to the horizontal position is the established danger-signal, or signal or debarring an engine-driver from going past the place where the signal is given. Now, the ordinary practice has been, and still is, to keep the semaphore arm down from that level position, and so to leave the line open for trains to pass, except when the line is blocked by a train or other source of danger on the block section in front of that semaphore, and only to raise the semaphore arm exceptionally as a signal of danger in front. The new change, or improvement, now made on the Caledonian Railway consists mainly in arranging that along a line of railway the semaphore arms are to be regularly and ordinarily kept up in the horizontal position for prohibiting the passage of any train, and that each is only to be put down when an approaching train is, by an electric signal from the cabin behind, announced to the man in charge of that semaphore, as having entered on the block section behind, and when, further, that man has, by an electrical signal sent forward to the next cabin in advance, inquired whether the section in advance of his own cabin is clear, and has received in return an electrical signal meaning "*The line is clear: you may put down your debarring signal, and let the train pass your cabin.*" The main effect of this is, that along a line of railway the signals are to be regularly and ordinarily standing up in the debarring position against allowing any train to pass; but that just as each train approaches, and usually before it has come in sight, they go down almost as if by magic, and so open the way in front of the train, if the line is ascertained to be duly safe in front; and that immediately on the passage of the train they go up again, and by remaining up keep the road closed against any engine or train whose approach has not been duly announced in advance so as to be known at the first and second cabins in front of it, and kept closed, unless the entire block section between those two cabins is known to have been left clear by the last preceding engine or train having quitted it; and is sufficiently presumed not to have met with any other obstruction, by shunting of carriages or waggons, or by accident, or in any other way.

This new arrangement, which appears to be a very important improvement, has already been brought into action with success on several sections of the Caledonian Railway; and it is being extended as rapidly as possible on the lines of the Caledonian Company, where the ordinary mode of working the block system has hitherto been adopted.

The mechanisms and arrangements I have now briefly mentioned are only a portion of the numerous contrivances in use for abatement of danger in railway traffic. It is to be understood that by no mechanisms whatever can perfect immunity from accidents be expected. The mechanisms are liable to break or to go wrong. They must be worked by men, and the men are liable to make mistakes or failures. We shall continue to have accidents; but, if we cannot do away with every danger, that is no reason why we should not abate as many dangers as we can.

Within the past twenty years very remarkable progress has been made in steam navigation generally, and more especially, I would say, in oceanic steam navigation. In this we meet with the realisation of great practical results from the combination of improved mechanical appliances, and of physical processes depending on a more advanced knowledge of thermodynamic science.

The progress in oceanic steam navigation is due mainly to the introduction jointly of the screw propeller, the compound engine, steam jacketing of the cylinders, superheated steam, and the surface-condenser.

The screw propeller, in its original struggle for existence, when it came into competition with its more fully developed rival, the paddle-wheel, met with favouring circumstances in the want then strongly felt of means suitable for giving a small auxiliary steam-power to ships arranged for being chiefly propelled by sails. For the accomplishment of this end the paddle-wheel was ill suited; and so the screw propeller got a good beginning for use on long oceanic voyages. Afterwards, in the course of years, there followed a long series of new inventions and improved designs in the adaptation of the steam-engine for working advantageously with the new propeller; and it has resulted that now, instead of the screw being used as an auxiliary to the sails, the sails are more commonly provided as auxiliaries to the screw. For long oceanic voyages it became very important or essential to get better economy in the consumption of fuel. In order to economise fuel, high-pressure steam, with a high degree of expansion and with condensation, was necessary. This led to the practical adaptation for the propulsion of vessels of the compound engine, an old invention which originated with Hornblower in the latter part of the last century, and was afterwards further developed by Wolff. The high degrees of expansion could not be advantageously used in cylinders heated only by the ordinary supply of steam admitted to them for driving the piston; and more especially when that steam was boiled off directly from water without the introduction of additional heat to it after its evaporation. The knowledge of this, which was derived through important advances made in thermo-dynamic science, led to the introduction into ordinary use in steam navigation of steam-jacketed cylinders, and to the ordinary use also of superheated steam. With increased efforts towards economy of space in the hold of the ship, which became the more essential when very long voyages were to be undertaken, and with the new requirement of greatly increased pressure in the steam, the old marine boilers, with their flues of riveted plates, were superseded by tubular boilers more compact in their dimensions and better adapted for resisting the high pressure of the steam. In connection with these various changes the old difficulty of the growth of stony incrustations in the boilers became aggravated rather than in any way diminished. As the only available remedy for this, there ensued the practical development and the very general introduction of the previously known but scarcely at all used principle of surface condensation instead of condensation by injection. A supply of distilled water from the condenser is thus maintained for feeding the boilers, and incrustations are avoided. The consumption of coal is often found now to be reduced to about 2 lbs. per indicated horse-power per hour, from having been 4 or 5 lbs. in good engines in times previous to about twenty years ago.

Before the times of ocean telegraph cables, very little had been done in deep-sea sounding; but when the laying of ocean cables came first to be contemplated, and when it came afterwards to be realised, the obtaining of numerous soundings became a matter of essential practical importance. In the ordinary practice of deep-sea sounding, as carried on, both before and since the times of ocean telegraph cables, until a year or two ago, a hempen rope or cord was used as the sounding line, and a very heavy sinker, usually weighing from two to four hundredweight, was required to draw down the hempen line with sufficient speed, because the frictional resistance of the water to that large and rough line moving at any suitable speed was very great. The sinker could not be brought up again from great depths; and arrangements were provided, by means of a kind of trigger apparatus, so that when the bottom was reached the sinker was detached from the line and was left lying lost on the bottom; the line being drawn up without the sinker, but with only a tube, of no great weight, adapted for receiving and carrying away a specimen of the bottom. For the operation of drawing up the hempen line with this tube attached, steam power has been ordinarily used, and practically must be regarded as necessary.

A great improvement has within the last two or three years been devised and practically developed by Sir William Thomson. Instead of using a hempen sounding line, or a cord of any kind, he uses a single steel wire of the kind manufactured as pianoforte wire. He has devised a new machine for letting down into the sea the wire with its sinker, and for bringing both the wire and the sinker up again when the bottom has been reached. With his apparatus, in its earliest arrangement and before it had arrived at its present advanced condition of improvement, he sounded, in June 1872, in the Bay of Biscay, in a depth of 2,700 fathoms, or a little more than three miles, and brought up again his sinker of 30 lbs. weight, after it had touched the bottom; and brought up also an abundant specimen of ooze from the bottom, in a suitably arranged tube attached at the lower end of the sinker.

An important feature in his machine consists in a friction-brake arrangement, by which an exactly adjusted resistance can be applied to the drum or pulley which holds the wire coiled round its circumference, and which, on being allowed to revolve, lets the wire run off it down into the sea. The resistance is adjusted so as to be always less than enough to bear up the weight of the lead or iron sinker, together with the weight of the suspending wire, and more than enough to bear up the weight of the wire alone. Thus it results that the arrival of the sinker at the bottom is indicated very exactly on board the ship by the sudden cessation of the revolving motion of the drum from which the wire was unrolling.

Another novel feature of great importance consists in the introduction of an additional hauling-up drum or pulley arranged to act as an auxiliary to the main drum during the hauling-up process. The auxiliary drum has the wire passed once or twice round its circumference at the time of hauling up, and is turned by men so as to give to the wire extending from it into the sea most of the pull requisite for drawing it up out of the sea, and it passes the wire forward to the main drum, there to be rolled in coils, relieved from the severe pull of the wire and sinker hanging in the water. Thus the main drum is saved from being crushed or crumpled by the excessive inward pressure which would result from two or three thousand coils of very tight wire, if that drum unaided were required to do the whole work of hauling up the wire and sinker.

The wire, though exposed to the sea-water, is preserved against rust by being kept constantly, when out of use, either immersed in or moistened with caustic soda. The fact that steel and iron may be preserved from rust by alkali is well known to chemists, and is considered to result from the effect of the alkali in neutralising the carbonic acid contained in the water, as the carbonic acid appears to be the chief cause of the rusting of steel and iron.

This new method of sounding, depending on the use of pianoforte wire, was first publicly explained by Sir William Thomson in the Mechanical Section of the British Association at the Brighton meeting two years ago; and in the interval which has since elapsed, it has come rapidly into important practical use.

I have to-day already brought under your notice a system of elaborately contrived and extensively practised methods of signalling and otherwise arranging for the safety of trains in motion on railways. These methods, in the aggregate, as we have them at present, may be looked on as the result of a gradual development, which, through design and intelligent selection, has been taking place during the last twenty or thirty years, or more. In contrast with this I have now to mention a reform towards abatement of dangers at sea, which at present is only in an incipient stage of its practical application, but which I am sure must soon grow into one of the important reforms of the future. I refer to the provision of means whereby every important lighthouse shall, as soon as it is descried, not only make known to the navigator that a light is visible, but also that it shall give him the much more important information of what light it is; that, in fact, it shall distinguish itself to him from all other lights either stationed on land or carried by ships out at sea. The rendering of lighthouses each readily distinguishable from every other light, by rapid timed occultations, was urged on public attention by Charles Babbage about twenty or twenty-three years ago, in connection with a like proposal of his for telegraphic signalling by occulting lights. His admirable idea, however, so far as it related to the distinguishing of lighthouses, has unhappily been left almost entirely neglected until quite recently. Although I say it was almost entirely neglected, yet very important steps in the direction of the object proposed were taken many years ago by Messrs. Stevenson, engineers to the Commissioners of Northern Lights, and the flashing and intermittent lights introduced by them, and now used, although too sparingly, in various parts of the world, constituted a very great improvement in respect to distinctiveness. The first practical introduction of an intermittent extinction of a gaslight, which is a method now likely to become fruitful in important applications with further developments, was made many years ago by Mr. Wilson at Troon; and an admirable application of this plan by the Messrs. Stevenson to carry out the principle of rapid signalling is to be seen in the Ardrossan Harbour light, which is alternately visible for two seconds, and then for two seconds is so nearly extinguished as to be invisible. The whole period—four seconds—is, I suppose, the shortest of any lighthouse in the world. This light fulfils the condition of being known to be the light which it is, within five or ten seconds of its being first perceived; and thus, in respect to distinctiveness, I trust that I may without mistake say it is the best light in the world. Mr. John Wigham has succeeded in constructing large burners for the combustion of gas in lighthouses in general, including those of the first order, and embracing both fixed lights and revolving lights. He has also, in both these cases, applied with the most striking success the principle of occultation. Dr. Tyndall, in his reports to the Board of Trade, has dwelt frequently and emphatically on the ease with which gas lends itself to the individualisation of lights. By its application, he affirms that by simple arrangements it would be possible to make every lighthouse declare its own name. Within about the last two or three years the subject has been taken up energetically by Sir William Thomson. He has become strongly impressed with the enormous importance of the object in question. He has perseveringly laboured in making trials in various ways, both by the method of partially extinguishing gas flames and by the method of revolving screens; and I have pleasure in stating that, as a result of his efforts, a self-signalling apparatus is now constructed for the Belfast Harbour Commissioners, who are preparing to bring it into immediate use at the screw-pile lighthouse at the entrance of the harbour of Belfast. I shall not now enter on any description of this arrangement, as I understand that the apparatus, which has already been temporarily erected for trial in the lighthouse, and has shown good results, is to be exhibited and explained to this Section by Mr. Bottomley, who, as a member of the Board of Harbour Commissioners, has taken an active part in the promotion of the undertaking.

I wish next to make mention of the very remarkable works at present in progress in the harbour of Dublin, under the designs and under the charge of Mr. Bindon Stoney. In order to form quay walls with their foundations necessarily deep under water, he constructs on land gigantic blocks of artificial stone, or, as we may say, of concrete masonry, each of which is about 350 tons in weight, and which are accurately formed to a required shape. After the solidification of the concrete, he carries them away and deposits them on an accurately levelled bottom of sea, so that they fit closely together, and form so much of the quay wall in height as to reach above the low tide level; and so as to allow of the completion of the wall above by building in the usual manner by tidal work, and to allow of the whole structure being carried out without the use of coffer-dams. These operations are on a scale of magnitude far surpassing anything done before in the construction and moving of artificial stone blocks. They are carried out with machinery and other appliances for the removal and the placing of the blocks, and for other requirements of the undertaking, which are remarkable for boldness of conception and ingenuity of contrivance. The new methods of construction devised and applied in these works by Mr. Stoney are recognised as being admirably suited for the local circumstances of the site of the works in the harbour of Dublin, and their various arrangements form a very important extension of the methods of construction available to engineers for river and harbour works.

While progress has been made with gigantic strides in many directions, in engineering and in mechanics generally; while railways, steamboats, and electric telegraphs have extended their wonders to the most distant parts of the world; and while trade, with these aids, is bringing to our shores the produce even of the most distant places, to add to our comforts and our luxuries; yet, when we come to look to our homes, to the places where most of our population have to spend nearly the whole of their lives, I think we must find, with regret, that, in matters pertaining to the salubrity and general amenities of our towns and houses, as places for residence, due progress in improvement has not been made. Our house drainage arrangements are habitually disgracefully bad; and this I proclaim emphatically, alike in reference to the houses of the rich and the poor. We have got, since the early part of the present century, the benefit of the light of gas in our apartments; but we allow the pernicious products of combustion to gather in large quantities in the air we have to breathe; and in winter evenings we live with our heads in heated and vitiated air, while our feet are ventilated with a current of fresh, cold air, gliding along the floor towards the fire-place to be drawn uselessly up the chimney. A very few people have commenced to provide chimneys or flues to carry away the fumes of their more important gaslights, in like manner as we have chimneys for our ordinary fires. In mentioning this, however, as a suggestion of the course in which improvement ought to advance, I feel bound to offer a few words of caution against the introduction of flue pipes for the gas flames rashly, in such ways as to bring danger of their setting fire to the house. People have a strong tendency to require that such things as these should be concealed from view. In this case, however, special care should be taken against rashly placing them among the woodwork between the ceiling of the apartment and the floor of the room above or otherwise placing them in unsafe proximity to combustible materials. In many cases it would be better to place the flue exposed to view underneath the ceiling, and by introducing some accompanying ornamentation, to let the flue be regarded as a beneficent object not unpleasing to the eye.

The atmosphere of our large towns, where people live by hundreds of thousands all the year round, is not yet guarded against needless pollution by smoke, jealously, as it ought to be. Many of the wealthier inhabitants take refuge in living in the country, or in the suburbs of the town, as far away as they can from the most densely built and most smoky districts; but the great masses of the people, including many of all ranks, must live near their work, and for them at least greater exertions are due than have yet been made towards maintaining and improving the salubrity and the amenities of our towns. As to the abatement or prevention of smoke from the furnaces of steam-engines, the main requisites have long been very well known; but sufficient energy and determination have not yet been manifested towards securing their due application in practice. In too many cases futile plans have been tried, and on being soon abandoned have left a strong impression against the trying of more experiments; and this may account in part for the introduction of real improvements having been so slow. Smoke occurs when fresh coal is thrown suddenly, in too large quantity at once, upon a hot fire. By extreme care a fireman may throw coal into his furnace so gradually as to make very little smoke; but mechanical arrangements for introducing constantly and uniformly the new supply of fresh coal have been devised, and several of these have been such as to reduce the smoke emitted to almost nothing. I have seen in the neighbourhood of Glasgow, at a large manufacturing establishment at Thornliebank, one method which is applied to about thirty ordinary 40-horse-power boilers, in which upwards of 100 tons of coal are daily burned, and from the chimneys of which not more smoke is emitted than from many a kitchen fire. This method is under the patent of Messrs. Vicars, of Liverpool, and it seems to work very well. It has been about two years in work there. It was introduced at a time when coal was exceedingly high in price, as much to effect economy in fuel as to prevent smoke; and although the first cost was somewhere about 130*l.* per boiler, the proprietor considers himself to be already more than recouped for his outlay, as a saving of fully 12 per cent. in the fuel consumed was effected. At the same works I have also seen in operation the method of Messrs. Haworth and Horsfall, of Todmorden, which has, I am told, in certain circumstances, some advantages over the other. In this, as in the other, the coal is fed in uniformly by mechanical arrangements. The mechanism is different in the two cases, but the result in the motion communicated to the coal is very much alike in both. The bed of coal, which is gradually supplied in front, is caused to travel along the bars towards the inner end of the furnace, and the combustion proceeds in a very uniform manner in conditions highly favourable to economy of fuel, and without the emission of almost any visible smoke.

These two methods I have mentioned because they appear both to work very successfully in practice, while they both bring into effect the principle of action of the fuel which has long appeared to me to be the best that can be adopted for ordinary cases of steam-engine boilers.

I have now occupied, I think, enough of your time, and so I will conclude. I have endeavoured to select out of the wide range of subjects which fall within the scope of the Mechanical Section of the British Association, a few which have come more particularly under my own notice, and on which I thought it was in my power to give intelligence that might be interesting as to past progress, and suggestions that might be useful towards extension of improvements in the future.

SCIENTIFIC SERIALS

Archives des Sciences Physiques et Naturelles, No. 198.—M. C. Marignac contributes a paper On the simultaneous diffusion of certain salts, and gives long tables of the results of his experiments.—M. Marc Micheli gives a note of eighteen pages in length, On the Onagraceæ of Brazil, of which the greater part is taken up with the genus Jussiæa. He sums up the distribution thus:—

		N. America.	Mexico.	Antilles.	Guyane.	Pacific States	Brazil.
Eujussieaa	23	1	2	5	7	7	22
Oligospermum	12	2	3	4	5	4	10
Macrocarpon	4	1	2	2	2	2	4
		4	7	11	14	13	36

- M. Maurice de Tribolet gives a concise history of the study of the genus Nerinæa, and gives analytical tables showing the distribution of species in the Jurassic beds of the Jura.—The meteorological observations made at Geneva, under Prof. Plantamour, during May, conclude the number.

SOCIETIES AND ACADEMIES

Paris

Academy of Sciences, Aug. 31.—M. Faye in the chair.—The following papers were read:—Astronomy at the Italian Spectroscopic Society, by M. Faye. This was a reply to some criticisms of P. Secchi. The author pointed out that P. Secchi's theory of sunspots was a return to the idea announced by Galileo in 1612, the clouds being buried in the body of the sun instead of floating above it. The theory advanced by the author on the other hand had been pronounced by Mr. Langley to be a *vera causa*. This *vera causa*, according to M. Faye, is nothing more than a law of hydrodynamics, perfectly established for terrestrial air and water currents.—Remarks on the fish of the Algerian Sahara, by M. P. Gervais. The remarks refer to species of *Coptodon* and *Cyprinodon*, the former of which had been cited by M. Cosson as proving the continuity of the sheet of water which extended over this region.—Note on the development of the contractile coat of the vessels, an anatomical paper by M. C. Rouget. New researches undertaken by the author on amphibian larvæ establish beyond doubt the contractibility of the ramified protoplasmic cells observed last year in the vessels of the hyaloid membrane of the adult frog.—On winged *Phylloxera* and its progeniture, by M. Balbiani. The author points out the complete analogy between *Phylloxera vastatrix* and the *Phylloxera* of the oak.—New observations on the migrations of *Phylloxera* to the surface of the soil and on the effects of the method of submersion, a letter from M. G. Bazille to M. Dumas. The letter contained a note, published in the *Messager du Midi.*—M. P. Mouillefert addressed also a letter containing observations on the employment of the chief insecticides from experiments tried in the laboratory at Cognac and on the vines of the neighbourhood.—M. P. Rohart addressed a letter on the action exercised by the soil on insecticide gases.—Other communications relating to *Phylloxera* were received from MM. Delfan, A. Richard, Gauthier, L. Rousseau, &c.—On a physiological phenomenon produced by excess of imagination, a letter from M. P. Volpicelli to M. Chevreul. Two experiments were made with magnets upon nervous subjects, to see if the effects produced were really magnetic or due to the imagination. In the first experiment a piece of unmagnetised iron was shown to the patient, who immediately fell into convulsions. In the next experiment a magnet was placed in the hand of a nervous subject, who at the end of a few seconds became so over-excited that the magnet was removed. That the effect thus produced was due to the sight of the magnet was proved by hiding several powerful magnets in the chair occupied by the same individual, who when thus unconscious of their presence experienced no ill effect. M. Chevreul made some remarks *à propos* of the foregoing paper on certain other illusions, such as the divining pendulum and divining ring.—Remarks on recent researches concerning the explosion of powder, by MM. Roux and Sarrau. The authors pointed out the agreement between certain of the results obtained by them and by MM. Noble and Abel in their recent communications to the Academy.—New note on the tail of Coggia's Comet, by M. A. Barthélemy. The theory of a repulsive force emanating from the sun requires, according to the author, that the axis of the tail should always be a prolongation of the radius vector. With Coggia's Comet, however, as observed by M. Heiss on July 5, the tail made an angle of 160° with the radius vector. The facts appear to the author to be simply explicable by the hypothesis of an interplanetary medium submitted to the attractive action of the sun, through which medium the comet travels with an increasing velocity; fans and jets are supposed to be the result of the sun's attraction on the denser portions of the cometary matter.—On a new theory of the formation of comets and their tails, by M. Virlet d'Aoust. In 1835 the author suggested the hypothesis that comets were nascent stars—the internal and still incandescent portions shining through cracks in the dark surface. This view was afterwards abandoned for Saigey's hypothesis, which considered the tails of comets as the result of the reflection of their light on an atmosphere which they drew after them. This opinion was again modified to meet the researches of Weiss, Schiaparelli, Klinkerfues, and Oppolzer, who showed the connection between the comets of 1862 and 1866, of Biela and Pogson, and the annular meteor streams which give us the August and November shooting stars. The author then asked whether comets did not equally belong to rings which had given rise to their existence, and if the light emitted by their tails did not simply result from the reflection of light from the nucleus on to the cosmical particles which constituted the rings on which they seemed to depend. The recent researches upon Coggia's Comet confirm this view in the author's opinion.—On a new model of prism for direct vision spectroscopes, by M. J. G. Hofmann.—On some points in the anatomy of the common mussel (*Mytilus edulis*), by M. Ad. Sabatier.

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THURSDAY, SEPTEMBER 17, 1874

THE EDUCATION OF WOMEN

NONE of the subjects discussed at the recent meeting of the British Association at Belfast were of greater practical importance than the one introduced to the notice of the Economic Section by Mrs. Grey in her paper on the Science of Education, and supplemented by the address afterwards delivered by her at a meeting held under the auspices of the National Union for Improving the Education of Women of all Classes. So much nonsense is talked and written on the theme of the higher education of women, the utterances even of some of those who are looked on as authorities on the question are too often so doctrinaire and unpractical on one side or the other, that it is a relief to read the well-considered and thoughtful reflections of one who has bestowed much labour and serious thought upon it, and who has given evidence that she is wedded to no preconceived views. The crowded attendance at the Section when Mrs. Grey's paper and the two which followed it—also by ladies—were read, and the lengthened and animated discussion to which they gave rise, sufficiently evince the wide interest felt in the subject by those who attended the meetings of the Association.

The branch which specially concerns us is the extent to which instruction in some or all of the various branches of science should enter into the liberal education of women; and this again is but a phase of the more general question as to the mode in which, if at all, the education of girls should differ from that of boys. We may set aside on the present occasion as a subject of too great importance to be discussed in a general article like this, the much-vexed question of the Medical Education of Women. With regard to the difference which has been established by general custom or prejudice between the ordinary curriculum of the studies of boys and girls, Miss Davies has pointed out with great force, in one of her Essays on the Higher Education of Women, what appear at first sight some glaring inconsistencies and absurdities. To boys who are destined for a mercantile life or a public career, an intimate acquaintance with French and German is now almost indispensable; Latin and Greek are therefore almost universally taught in boys' schools, while the modern languages are considered an essential part of the course of study of a girl, to whom they will be of much less service. A fair knowledge of the elements of physics and chemistry would be of immense advantage to a woman in the management of a household; but these are subjects considered by many to be decidedly unfeminine. Music is the most inexhaustible and harmless recreation for the mind overtasked with the burden of daily cares; but music hardly comes within the scope of a boy's education, at least in this country; while it is almost compulsory on girls, whether they have the talent for it or not, and who have at all events abundant other occupation, such as needle-work, for their leisure moments. The earliest years of a child's life are almost entirely regulated, for good or for evil, by the mother and her female dependents; but any knowledge of human physiology or hygiene has been till recently almost forbidden to the girl on the score of delicacy. May we not sum up by saying that few men have the leisure, after they arrive at manhood, for pursuing the studies of their youth; while an enormous number of women of the upper and middle classes would be most thankful for a rational substitute for the purposeless vacuity in which they are at present forced to spend a large portion of their time? And yet in the face of this it is still the orthodox creed that the education which any English gentleman gets or can get at a public school or University is too broad or too deep for the mass of women of the same class.

An almost ludicrous instance of the difficulty which is experienced practically in the attempt to frame a curriculum of studies which shall be specially adapted for girls, was brought out in the recent debate in the Convocation of the University of London on the desirableness of admitting women to degrees. When the existing General Examination for women was instituted, a Committee of the Senate was appointed to draw up a scheme which should meet all the requirements of the case. After long deliberation, the extent to which it was found possible to deviate from the ordinatry Matriculation examination was this: Greek was made optional; and girls were allowed to take Botany if they wished instead of Chemistry, and Italian if they preferred it instead of German; they were also exempted from all the books of Euclid except the first, if they took Geography instead! The first of these indulgences is now extended to boys; and the other differences are so trivial that we are glad to see that another Committee of the Senate has already recommended that the examination be altogether assimilated to that for Matriculation. When this is done, it may possibly occur to the Senate that there will be no object in keeping up a distinction of name between the two; and how will it then be possible to refuse to women examinations which shall be equivalent to those that admit men to degrees, at least in the Faculties of Arts, Science, and Laws? We do not propose here to discuss the expediency of nominally permitting women to take degrees in our universities; but there is one aspect of the question which has hardly been sufficiently considered by those who oppose the innovation. A university degree is the acknowledged hall-mark of a certain standard of education for men who make teaching their profession. A very large number of women are equally dependent on teaching as a means of livelihood; notwithstanding the many additional facilities given them of late years for acquiring knowledge, they have at present no equivalent test of their qualifications; and as long as this is the case the really competent governess or schoolmistress will always be subject to unequal competition from her incompetent sisters, and the rising generation of both boys and girls will be the sufferers.

The vision that frightens many from looking with candid and impartial mind at the problem of the higher education of women is the fear that the educated woman will be lifted out of what we are pleased to term her sphere, and rendered unfit for what man considers to be her duties. But the admirers of the uneducated woman may take comfort in the assurance given them by Prof. Fawcett at the Brighton meeting of the British Association, that whatever facilities are offered for improving their minds, there will still be left for many years an ample supply of those who prefer to remain ignorant and uncultured to satisfy all demands. In the noble address delivered by Prof. Huxley at Belfast, he insisted, with all the force of his calm eloquence, on the folly of making a bugbear of logical consequences; and in no science is there more need for this exhortation than in that of education. Mrs. Grey well put it that no education is worthy of the name that does not at least aim at a right training of the three departments of the mind—the reasoning faculties to determine the right from the wrong, the emotional to follow the right when found, and the imaginative to conceive the perfect ideal of all goodness. In determining a course of education, whether for boys or girls, when we have once satisfied ourselves that our principles are sound, let us unhesitatingly follow them out, letting the possible consequences take care of themselves; and we may feel sure that the conclusions to which we shall be led will stand the test of experience.

The point which we think should be most prominently brought forward by the advocates of a reform in female education is not so much the desirableness of turning its future current in any one direction, as the necessity for removing all trammels and barriers raised by man's ignorance or prejudice. On this ground we sympathise most heartily in all the efforts now being made to widen the basis of the education of women, whether in the way of special colleges, university examinations, or courses of lectures involving severe study. Let us first of all—divesting ourselves of all preconceived theories on the subject, whether social, metaphysical, or physiological—give free scope to the faculties of woman before we begin to dogmatise on the extent to which these faculties will bear cultivation. Natural Selection will point out the occupations in which the female mind will excel; and the Survival of the Fittest will determine the professions in which woman can successfully compete with man. And every one who believes that faculties were originally endowed or gradually evolved for the purpose of being used, and powers for the sake of being exercised, must rejoice at every fresh extension of the field in which they may be employed.

DE BOISBAUDRAN ON SPECTRES LUMINEUX

Spectres Prismatiques et en Longueurs d'Ondes destinés aux Recherches de Chimie Minérale. Par M. Lecoq de Boisbaudran, avec Atlas des Spectres. (Paris: Gauthier-Villars, 1874).

THE spectrum maps of Kirchhoff, Huggins, Angström, and Thalen are so complete that little has been left for later observers except the filling up of some details. Angström's discovery that the bright lines which form the spectrum of the electric spark are partly due to the air or other gaseous medium traversed by the spark, partly to the vapour of the metallic poles, formed an epoch in the history of spectrum analysis; and the publication of the fine map of the solar spectrum by Kirchhoff (founded on the great original work of Fraunhofer), in which the positions of a large number of the metallic lines are carefully laid down, gave a great impulse to the pursuit of this branch of physical science. For the discovery of the new metals, cæsium, rubidium, thallium, and indium, we are indebted to spectroscopic analysis. In a paper communicated to the Royal Society in 1863, Mr. Huggins gave a valuable map of the bright lines of the metals, as seen through a system of prisms adjusted for a minimum deviation of the line *D* of Fraunhofer. This was followed by the works of Thalen and Mascart, in which the positions of the metal lines are given in wave-lengths. The results obtained by Thalen are incorporated in the great work of Angström on the solar spectrum.

To observe the metal lines, the method usually employed is to pass the spark from a Ruhmkorff's machine, having a condenser connected with the fine wire, between poles of different metals. The air lines which come into view at the same time are easily distinguished by well-known characters from the metal lines, and were used by Mr. Huggins to fix the positions of the latter. In some cases the metal lines were obtained by drawing sparks from solutions of the chlorides.

In the work of M. Lecoq de Boisbaudran, two methods are chiefly followed for obtaining the spectra of the elements and of certain compound bodies. The first is the ordinary method of heating the body in the flame of a Bunsen burner; the second is to pass short electrical sparks from a Ruhmkorff's coil, *without condenser*, between a solution of the chloride of the metal and a fine platinum wire suspended above the solution. In the latter case the following is the method of experimenting usually employed by him:—The metallic solution is contained in a short glass tube, into the lower end of which a platinum wire is hermetically sealed. Another wire of platinum, or, still better, of iridium, attached to an insulating support, is adjusted at a distance of two or three millimetres from the surface of the liquid. An essential condition to the success of the experiment is to make the free wire positive, and the liquid negative. If this condition is reversed, the spectrum of the solution seldom appears, but is replaced by the ordinary air spectrum. In some cases, as with the alkaline salts, a fine spectrum is obtained by passing sparks between a fused bead of the salt and a platinum wire heated to redness in a Bunsen or spirit flame. According to M. Lecoq de Boisbaudran, the spectrum produced in this way is not only more brilliant, but is richer in metallic lines than that of the solution. The method of taking sparks in air between metallic poles has been employed in the work before us only in the cases of aluminium and lead. The spectroscope employed was formed of a single prism of heavy glass, with a collimator, and telescope moveable on a graduated arc. An illuminated scale, projected from the anterior surface of the prism, was seen above the spectrum, and its indications were reduced to wave-lengths by comparison with the wave-lengths of certain solar and metallic lines, as determined by Fraunhofer, Mascart, Angström, and Thalen.

In a series of twenty-eight finely-executed engravings, M. Lecoq de Boisbaudran has given delineations of the spectra of a large number of bodies referred to the arbitrary scale of his spectroscope, and also in wave-lengths. Except in a few cases, he has not attempted to represent the feebly illuminated ground or continuous spectrum which in many instances extends over nearly the whole field of view. But the characters of the bright lines and bands are carefully represented, and a full description of them is given in the body of the work. The whole is designed to facilitate the application of spectrum analysis to mineral chemistry; and although some of the details may hereafter require correction, the work is well executed, and cannot fail to be of great value to the scientific and practical chemist. The frequent reproduction of the comparatively simple spectra of the metals obtained at the low temperature of the gas flame in elementary works of chemistry, unaccompanied by sufficient explanation, has tended to give rise to partial and even incorrect conceptions of the grandeur and extent of this subject. How many persons believe that the spectrum of sodium consists solely of a pair of fine lines corresponding to the double line *D* of the solar spectrum? How few know that at the high temperature of the electrical spark it exhibits three other pairs of well-defined lines, one in the orange, another in the yellow, and another in the green, together with a nebulous band on the confines of the blue? (Huggins). All these lines may easily be seen by passing the electrical spark in a non-luminous flame between a fused bead of sulphate or chloride of sodium and a platinum wire, together with a few other feeble lines, especially in the violet (Lecoq de Boisbaudran). The vivid line in the red, with its faint companion in the orange, which forms the ordinary spectrum of the compounds of lithium in the gas flame, gives place to a very different spectrum, when sparks are drawn from a solution of the lithium salts. The red ray still continues vivid, but it is surpassed in intensity by the orange, which is now the most characteristic of the lithium rays, while two new rays or lines come into view (λ 497·0, 460·4). With a solution either of the ferrous or ferric chloride, the electrical spark gives the numerous lines with great sharpness and accuracy of detail, which constitute the spectrum of metallic iron.

M. Lecoq de Boisbaudran gives a delineation of what he considers to be the spectrum of oxide of barium, as it appears after a prolonged heating of the chloride in the gas flame, and also of the spectra proper of the chloride, bromide, and iodide of barium, as obtained by heating those salts in the gas flame charged with hydrochloric acid, bromine, and iodine vapours respectively. These spectra are all different. Thus, in the case of the chloride, only slight traces of the lines and bands due to the oxide are seen, while six new lines appear which are very intense (A. Mitscherlich). On the interesting subject of the bright lines which compose the spectrum of the earth erbia and its phosphate, the following observations are made in the work before us:—"According to Bunsen and Bahr, the addition of a little phosphoric acid to solid erbia gives to that earth a greater emissive power and renders the lines sharper, without modifying their number or position. On repeating this experiment, I find that erbia alone and erbia to which phosphoric acid has been added give very different spectra. On comparing the spectra, the red is more developed in the light of the phosphate, whilst the green and the violet-blue are more vivid in that of the oxide."

The limits of this notice do not permit the discussion of questions of great interest in spectrum analysis, many of which promise soon to be fully resolved. The observation of Roscoe and Upton, that the broad bands characteristic of certain metallic compounds at the low temperature of the gas flame disappear at the higher temperature of the electrical discharge, and the view they have set forth, that in the former case the spectrum is that of the compound, in the latter case that of the metal, have received confirmation from later researches. Lockyer, in his valuable contributions to spectrum analysis, has shown that what he designates the shortest lines disappear first on reducing the pressure, and that the difference between the spectrum of the chloride and the spectrum of the metal is that under the same spark condition all the short lines are obliterated in the former case. The same investigator has observed that metallic elements of low specific gravity, such as sodium, calcium, magnesium, and aluminium widen their lines by increase of vapour density, while metallic elements of high specific gravity, such as iron, cobalt, and nickel, increase under the same condition the number of their lines.

THOMAS ANDREWS

OUR BOOK SHELF

Comets and the New Comet of 1874. By the Author of "Astronomy Simplified for General Reading." (London: William Tegg and Co., 1874.)

THIS book purposes to be "a complete popular account of all that is known of these wonderful bodies which are so great a perplexity to science:" but the work consists of only 56 pages, and it is needless to say that even a popular account of these bodies to be complete must extend over a much larger space. We think that a work on any subject in science, to be popular, that is written to be read by the public at large and not by persons who are conversant with the subject only, should not refer to explanations or theories that are not generally known, without a very intelligible explanation; theories of the action of observed phenomena should not be given without a very strong probability of their truth, or without a caution against their acceptance; and in dealing with a subject like the present one, when our knowledge is limited, and when there are so many different modes of explaining appearances, it behoves an author to use more than ordinary caution against the mention of anything that is not strictly in accordance with ascertained physical laws. On both these points the present book is at fault. As an instance, the author mentions M. Faye's theory of the repulsive power of the sun in virtue of its heat, and then urges objections to the theory without a word of explanation of it. Now to a person not conversant with the experiments on the repulsion of gases and solids by heat rays, the theory would seem absurd and contrary to experience; and so the author carries the day with the theory that the effect of solar heat upon the cometary matter is electrical in its action. Again, he says: "For example, the matter of comets is not possessed of concentric attraction even with reference to itself, neither is it possessed of chemical affinity for itself. This is fully established by the eccentric forms of comets and through conspicuous variations of shape and size." This is quite new to us. Again, after mentioning that Lexell's comet was entangled for about a month among the satellites of Jupiter, he says: "Is there another instance—a single analogy on record outside of cometary phenomena—of a body of dead matter under great velocity being actually barred and stopped in its path for four months, and then suddenly starting off again after being divested of its force for so long a period? What can the composition and resolution of forces do for us here? for here is the most wonderful problem ever submitted to their laws. What must be the amazing force of a body which, like an nspent cannon-ball impeded by a bank of earth, keeps pinning and grinding in its bed for four months, and hen suddenly goes off with unabated velocity as if it vere merely ricochetting from its point of interruption?"

Did the writer never hear that the motion of this omet was in strict accordance with the laws of gravi-ation, and Laplace used it for corrrecting the value of upiter's mass? In these cases, and in many others, the uthor has gone sadly astray. The accounts of the appear-nce of the different comets are good and clear and are vell worth reading, but one or two drawings of comets vould have improved matters considerably. There is a late at the beginning of the book, of the earth in a omet's tail, which draws somewhat on the imagination. want of soundness with reference to mechanical laws ppears throughout the book, for we read of the two arts of Biela's Comet having less mass to be acted upon y solar attraction than they had before separation, so at the original orbit must have been altered; and we ear of a comet altering capriciously its centre of gravity ith reference to solar attraction. The words orbit*u*al nd phosphor*o*us occur frequently, we hope for the last me. The book is spoilt by the endeavour to explain e appearances of comets without regard to the most ndamental physical laws which have so far been found be rigorously exact. G. M. S.

LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

Pollen-grains in the Air

MR. HUBERT AIRY'S letter printed in your issue of Sept. 3 ppears, to a great extent, to reconcile that gentleman's obser-ations with my own. My set of drawings have been made tirely from pollen-grains in the *dry* state, and in this condition n which of course it is wafted through the air) I find the pollen f plants fertilised by the wind, though belonging to the most idely dissociated natural orders, to be uniformly, as far as I ave been able to observe, nearly or perfectly spherical, with no rominences or furrows visible on magnifying about 250. A ery short immersion in glycerine would cause the protrusion of e intine through the weak spots of the extine, and would give the grains of birch and hazel the spherically triangular appear-nce described by Mr. Airy, and represented in some of the plates y an old German writer. ALFRED W. BENNETT

Penmaenmawr, Sept. 9

Fossils in Trap

WHEN examining the great exposure of trap and associated pper Silurian rocks at Cape Bon Ami, New Brunswick, I nexpectedly found fossils in the trap. I was at the time llecting agates and amygdals of calcite. One amygdal tracted my attention as singularly regular in shape. On taching it from the rock and examining it with the magnifying ass, I found it to be a coral, *Favosites gothlandica*. The fossil is arly circular. Its greatest diameter is $1\frac{7}{10}$ in., its smallest ameter $1\frac{5}{10}$ in., its greatest thickness is $\frac{1}{2}$ in. Notwithstanding e rubbing by exposure on the shore, many of the cells e quite distinct: the side attached to the trap is without lls. I found a second specimen of a similar coral in other part of the trap-rock. Of this the length is 1 in., the idth $\frac{8}{10}$. The exposed part is a section having the structure rfect; it is slightly weathered. The fossil is indissolubly ited with the trap, its sharp septa penetrating it: the trap of e specimen is very compact.

These fossils are derived from the associated strata of Niagara mestone: Wenlock limestone age.

The strata have been coral reefs: they are filled with corals, *avosites* and *Cyathophylla*. I collected magnificent specimens f the former, also *Crinoid* joint, *Orthis* sp.? *Strophomena de-ressa*, *Atrypa reticularis*, *Rhynchonella* sp., *Athyris nitida*, *rthoceras* sp.?

The fossils are easily detached from the strata.

I have no doubt that the notice of the occurrence of the fossils in trap will be new to many of your readers. In all my investigations I have not met with a similar occurrence. The first example proves that the trap was, at least, in a *plastic* state when the fossil dropped into it. The second proves that it was in a *fluid* state.

This is all very satisfactory to us, as proving that trap is a true *lava*, although the Wernerian might thereby infer that the trap was a sedimentary rock. The section of the coral in the trap is as perfect as sections of *Lithostrontion* in the Lower Carboniferous limestone of East River Picton in our museum collection.

By what process were these fossils preserved from destruction in the molten trap? D. HONEYMAN

Halifax, Nova Scotia, Aug. 27

[Our correspondent does not define in what sense he uses the vague word "trap." Fossils, both animal and vegetable, are of common occurrence in some kinds of "trap," *e.g.* in the different forms of tuff. We presume that the specimens he refers to were of true basalt, or some other form of crystalline, and once molten igneous rock. If so the fact is interesting, though possibly some of our readers may be able to adduce similar cases.—ED.]

Curious Rainbow

THREE or four days ago I observed a phenomenon which may possibly be interesting to some of your readers. I was standing on a hillside, about 200 ft. above the sea, and saw a rainbow of the ordinary description, very vivid and extending to the horizon at both ends of the arch; outside this was a secondary bow, also very distinct, and inside the primary bow was a series of coloured bands, to all appearance identical with the series in the primary bow from the green to the violet, so placed that the green of this third bow was next to the violet of the primary bow, and the violet of the third bow the innermost of all. There was no appearance of any superposition of colours, and the third bow was nearly as bright as the primary, and the interval between them was hardly appreciable. The whole series was concentric. I have not observed any notice, in works on the subject, of a phenomenon similar to this, or any hint that it might be expected according to the geometrical or physical theories of the rainbow, and therefore think the appearance may possibly be of rare occurrence. R. P. A. SWETTENHAM

Glen Caladh, Kyles of Bute, Sept. 5

Polarisation of the Aurora

IN answer to Mr. Procter's first question (vol. x. p. 355), I would refer him to NATURE, vol. vii., p. 201, where he will find an account of observations of the polarisation of the zodiacal light, and of the aurora, by Mr. Ranyard, who appears to have used a double image prism and Savart, during the great aurora of Feb. 4, 1872, and to have detected no polarisation. He refers also to some observations made upon the small aurora of Nov. 11, 1871, in which he could detect no polarisation. The only other account of observations that I have met with are contained in the report of Prof. Stephen Alexander on his expedition to Labrador, given in Appendix 21 of the United States Coast Survey Report for 1860, p. 30. He found strong polarisation with a Savart's polariscope, and, what is most remarkable, thought that the dark parts of the aurora gave the strongest polarisation. This was at the beginning of July. He was in latitude about 60°, and the observations appear to have been made near midnight. But he does not state whether there was twilight or traces of air polarisation at the time, nor does he give the plane of polarisation.

Cheltenham J. A. FLEMING

FRANCIS EDMUND ANSTIE, M.D., F.R.C.P.

ON Saturday, 12th inst., in his forty-first year, after an illness of only four days' duration, died Dr. F. E. Anstie, from the consequences of a dissection-wound inflicted while he was investigating the causes of a serious and somewhat mysterious disease which had for some time prevailed in a large school at Wandsworth, and had rapidly carried off several of the pupils. Thus he must be enrolled in the list of those who have fallen in the cause of scientific investigation.

Dr. Anstie was a student of King's College, and took his doctor's degree at the University of London in 1858, since which time he has devoted much of his leisure to the investigation of therapeutical and pathological problems. His work on "Stimulants and Narcotics," published in 1864, first brought him into notice as an upholder of the value of alcohol as a nutritive agent, in contradistinction to the opinion of M. Lallemand, that its action is simply stimulant. In conjunction with Dr. Burdon-Sanderson he was one of the first in this country to direct attention to the Sphygmograph of his friend Prof. Marey, of Paris. Sanitary reform was another subject to which Dr. Anstie paid much attention, and with great success. His article on "Neuralgia" in Reynolds' "System of Medicine," and his important work on the same subject, made him well known as a physician, as did his papers in the *Practitioner*, of which he was the editor.

Dr. Anstie was physician to Westminster Hospital, where he was also lecturer on Medicine. The new physiological laboratory of that institution, which is to be opened next month, owes much to his energy; and no one, more than himself, looked forward to the opportunities it will afford for original investigation. Dr. Anstie's loss will be felt by a large circle of friends, whom he had an unusual power in making and retaining, on account of the genuineness and force of his character.

HIEROGLYPHIC TABLETS AND SCULPTURE IN EASTER ISLAND

EARLY last spring mention was made in NATURE (vol. ix. p. 351) of some photographs of inscribed tablets from Easter Island, which the Academy of Sciences at San Francisco had shortly before received from Mr. Croft, of Papeeti, Tahiti.

Up to that time only three tablets were known for certain to have been discovered in the island. From information, however, which has recently been received, it appears that there are now no less than five tablets at the Roman Catholic Mission in Tahiti; and one, obtained last year by the mate of a vessel wrecked on the island, is said to have been taken to San Francisco. Two others are in the National Museum at Santiago de Chili;[*] and casts from these, made under Mr. E. Reed's directions, were sent to England and Germany in 1873. This, however, is not all. Natives who are in the employ of planters at Papeeti inform Mr. Croft that incised tablets were formerly very numerous in Easter Island, but many were destroyed in intestine wars. Some are said to have contained descriptions of land and boundaries; others, directions for planting and fishing; many were connected with religion and mythology; and, more important than all, a few "contained the ancient history of the island, and its kings or ruling chiefs:" these, it was feared, might all have been destroyed, not by the natives themselves, but by direction of Roman Catholic priests, who, as in America at the time of the Spanish conquest, persuaded their first converts to burn and destroy a large number of records without discrimination. It is known, however, that a few remain in possession of the islanders, who are said to attach the greatest possible value to them.

Should no others prove to be historical, it is almost certain that one, at least, of those at Santiago, of which we have the plaster casts, answers this description. The tablet alluded to is fully described in the *Journal of the Anthropological Institute*,[†] where plates will be found of the hieroglyphics.

Some of the older natives of Easter Island are said still to possess the art of engraving tablets, and to be able to interpret them. But whether this refers to the ancient signs, or only to those which Señor G. de la Rosa found were used by the chiefs a hundred years ago, is at present doubtful. Dr. Philippi, of the University of Santiago, on the authority of Père Einaud, one of the French missionaries, says that the natives do not attach any meaning to the signs. Probably expert wood-carvers like the Easter Islanders would from time to time have replaced decayed tablets and multiplied others. They may also, very possibly, know from the general appearance of the hieroglyphics what they refer to, and yet not understand individual signs.

Before showing that it may prove an easy task for anyone acquainted with the Pacific to interpret the signs, provided he has some knowledge of the traditions of the Easter Islanders, it will be necessary to mention the legend of their origin as ascertained by Commodore Powell and Señor Gana from the missionaries on the spot (in 1868 and 1870). It is briefly this: that their ancestors arrived in two boats many years ago, each boat being under the command of a chief; and there is a distinct tradition that they had been expelled from Oparo, or Rapa-iti, an island 1,600 miles to the west.

Now there is a drift-current from that direction, that carries wood and other waifs to the shores of Easter Island; so that it is physically possible for a canoe or other vessel to have arrived by its aid. It is worth mentioning that the current turns round Easter Island, and then goes northwards.

Oparo, also, bears silent witness to the truth of the story. Though little more than seven miles in length, several of its hills are capped with stone forts; and there are platforms and stone houses as in Easter Island, as well as a fortress or temple in five stages (like the ruin of Pollanarrua, in Ceylon). It need scarcely be added that there are traditions of fierce wars and feuds in the island.[*] Unfortunately, little more than this is known about its antiquities and legends.

Passing by, with the bare mention, several symbolic practices of the Easter Islanders—for example, the enormous trouble that was taken by them to crown the great statues with huge tiaras of red tufa; the erection of effigies of their chiefs on platforms of squared stone, the masonry of which, Cook said, was "equal to any in England;" the peculiar form of the huts, like inverted boats; their moon-shaped shields, used only in dances (some with faces carved on the cusps, like the eagles' heads on the Phrygian peltas); the bi-fronted staffs or batons, which were held in the hands of the chiefs; and tattoo marks like those in Burmah and India,—all of which may possibly, by and by, aid us in discovering the land from which the mysterious chiefs of Easter Island originally came,—passing by these, we will confine our attention to the symbols which appear more immediately to relate to the arrival of vessels from Oparo, and seem to establish the tradition on an historical basis.

Few who have visited the Cnidus Shed at the British Museum can have failed to notice the emblematic carving on the back of one of the statues from Easter Island, at present deposited there. It was found under cover in the range of stone houses called "Taura Renga," in the centre of a chamber lined with wall slabs, and partly excavated from the cliff. The bas-reliefs faced the entrance, a small square door, with stone posts and lintel, in a rubble wall about 5 ft. in thickness. On the back of the head of the statue there is a bird, over which is a solar crown; and on either side a rapa, or steering paddle, with a human face on the spade-like blade.[†] A third but very much smaller rapa is carved on the back of the right ear of the statue, whilst four ovals are incised on the left. The lobes of both ears are greatly lengthened.

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[*] Two more are reported to have been taken by a surveying ship to Russia a few years ago, and another to Germany.

[†] Journ. Anthro. Inst., Jan. 1874. Trübner and Co.

[*] Captain Vine Hall, who spent a few hours there a year or two ago, gives the above particulars.

[†] There are wooden rapas in Easter Island, which are used only in the native dances.

Lower down on the back of the statue there are two herronias—symbolic animals, with albatross-like beaks, which are turned, not ungracefully, towards the bird. Immediately above the waist-belt of the statue—its only dress—there is a circle.

The explanation of these hieroglyphics is at once suggested by the story of the arrival of the chiefs. The two rapas, or steering paddles, were dedicated to the gods, and symbolise the vessels of the two chiefs. They were doubtless carved on the statue to commemorate their safe arrival. The two herronias may represent the chiefs themselves. The circle is the accepted emblem of life.

The same symbolism, though of a more realistic kind, may be recognised in the curious wooden images which are peculiar to Easter Island. They are mostly anatomical; that is, figures in which the ribs, vertebræ, and other bones are distinctly shown, as they would appear in a person suffering from extreme emaciation. They were styled by La Pérousse "squelettes." Nearly all of them have strongly marked Semitic features, a tuft on the chin, and highly symbolic carvings on the scalp; *e.g.*, herronias, double-headed birds, and a solar deity with rays round the head. The legs of these little images are uniformly short, and the ear-lobes enlarged. There is also very generally, if not always, a circle on the lower part of the back. It can hardly be doubted, in view of the symbolism which pervades almost everything in Easter Island, that these squelettes are connected with the story of the voyage from Oparo, and represent the half-starved condition in which it may well be conceived that the crews arrived.

In one of these images, in the Ethnographical Room at the British Museum, the head is perfectly smooth, which appears to intimate that it was shaven. It perhaps represents a priest; for we are informed that Roggewein, the discoverer of Easter Island in 1720, noticed a native with his head shaved, who had large "white balls" in his ears, and appeared very devout: the Dutch judged him to be a priest.

Returning to the tablets, of which casts are in the museum of the Anthropological Institute, it will be sufficient to mention that they are engraved with hieroglyphics on both sides, every part being covered with minute signs, apparently intended as actual representations of various forms of animal and vegetable life; as well as scenes and incidents such as were likely to have been met with among the islands in the Pacific. On the bottom line of what is considered to be the front face of the smaller tablet there is a procession of bird-headed men, who are approaching or standing before a pillar, or stone,* with two discs, or circles, on each side. Immediately before the first figure, which it is presumed is a chief, from his holding a staff in his hand, are two curved lines, the hieroglyphic for a boat or canoe. Behind the chief another bird-headed man is represented as kneeling down, and holding up his hands; he is probably a priest.† A third bird-headed figure follows without a staff. Then, after two small curves high up in the line of hieroglyphics—perhaps a sign for the moon,—there is a character with a bird's head and beak, of a different shape from those of the bird headed men. It has a crest on its head, and short wings, and is probably intended for a domestic fowl—the only land bird in Easter Island. It appears to be a victim about to be sacrificed. Two more bird-headed men, without staffs, follow in a certain stately order. Then there is a second sign or hieroglyphic for a boat, followed by another chief; and then a third sign for a boat, with a waved or zigzag line before it, which is perhaps intended to signify that the vessel which follows it was lost or driven away in some other direction by a storm. This last boat is followed by a bird-headed man without a staff.

The signs for the chiefs' vessels, it will be seen, agree in number with the large rapas, or steering paddles, upon the back of the stone statue; and the bird-headed chiefs answer to the two herronias. The diminutive steering paddle, represented apart from the others on the ear of the statue, may symbolise the same casualty that appears to be signified by the waved line, viz., that there was a third boat, which did not reach Easter Island. The small carving of a rapa would thus have been erected merely *in memoriam*. However this may be, taken in conjunction with the tradition, there can be little doubt that the hieroglyphics on the tablet and the carvings on the statue relate to a more important matter than the arrival of the chiefs.

As regards the signs generally, a considerable number have been identified as conventional representations of birds and animals which are not found in Easter Island; weapons, also, and other objects are introduced (*e.g.*, an Eastern bow), which belong to regions far to the west. Some of the identifications that have been suggested may be doubtful; but amongst those that will perhaps meet with general acceptance, by no means the least important are the hieroglyphics of three distinct types of men: (1) Tall, bird-headed men, with short legs, as in the wooden images. (2) Men with large ornaments or projections on each side the head, scarcely exaggerating the practice of enlarging the ear-lobes by inserting in them discs, or plugs of wood and other materials, which prevails in certain islands in the Pacific, as well as amongst the older races in India and Burmah. (3) Dog-faced men, or Negritos, with strangely shaped heads, which, from plates in the "Cruise of the *Curaçoa*," appear to be characteristic of the natives of the Solomon Islands, as well as the more westerly islands of the Fiji group. They squat like the dog-faced men in the tablets, whilst the large-eared men sit in the Eastern manner. The peculiar appearance of the head is explained by the custom of dressing and plastering the hair. Several of these Negritos are represented about the middle of the tablet as celebrating a fish-fête; the men dancing by themselves on one side, and the women in couples on the other. Two of the men with enlarged ear-lobes stand by as spectators.

Enough has perhaps been said to suggest the great importance of an early and systematic exploration, above and below ground, of Easter Island and Oparo, as almost unworked mines, abounding in matter of the greatest ethnological and anthropological interest.

J. PARK HARRISON

ON THE DISTRIBUTION OF THE HEAT DEVELOPED BY COLLISION *

MANY of our colleagues who have become aware of a fact in thermodynamics which it has been in our power recently to observe, think it possessed of so great an interest that I ought immediately to announce it to the Academy. It is as follows:—

During the forging, which has been very successful, of the ingot of platino-iridium for the standard metre, I at first remarked that it sometimes produced, under the action of the hammer, luminous streaks, having an oblique direction upon the lateral faces of the piece, when this, while cooling, was yet at the temperature of a dull red. I showed some of these effects to M. Fizeau, but they were then incomplete, and I have only lately succeeded in obtaining a good observation of the phenomenon, and in defining its character with perfect certainty.

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* Compare the legend of the "Emigration of Turi," Pol. Myth. p. 214. "Amongst the chiefs who landed there was one called Porua . . . the second (dog) they cut up raw as an offering for the gods . . . and built a second place, *and set up pillars for the spirits.*"

† See Pol. Myth. p. 136, where a priest is mentioned as accompanying a boat expedition.

* A paper read by M. Tresca before the Paris Academy of Sciences June 8.

It is known that when a bar of metal is lengthened by means of a powerful hammer on an anvil of the same form as the head of the latter, each blow produces, above and below, a symmetrical contraction, the effect of which is to give to the bar the aspect of a series of projections separated by small level spaces.

At the time of the collision, these spaces, which are formed before and behind the impress of the hammer, upon the upper and the lower face of the bar, are connected, at a certain moment, upon the lateral faces, by luminous lines passing from the one to the other, and presenting altogether the appearance of an X written in lines of fire. The phenomenon is only visible for a certain temperature of bar which is being wrought, but then each blow invariably produces its effect, and, in consequence of the confused mingling of the imprints, we see the entanglement of these crossed lines which encroach upon each other. These brilliant bands appear at the same moment as the collision, but they do not disappear with it, and their continuance was sufficiently prolonged to enable us to count six luminous cross-bars visible at one time, although developed by six successive blows of the hammer.

I have been able, moreover, to get this persistence confirmed by several persons in the foundries of M. Farcot, who, with the greatest kindness, placed his services at the disposal of the Metric Commission for the execution of the work.

Although the lines of the cross-bars appeared to us all rectilinear, and although we could not compare them to anything better than two series of straight lines, parallel and intercrossed, we think it will be indispensable to determine their form more exactly by appropriate processes, and to discuss it with the greatest care.

It is well known that hammering develops heat in the bodies hammered; thermodynamics teaches us that these thermal effects ought to be regarded as the result of mechanical work or of *demi-force vive* exerted during the collision, but the precise place in which the calorific development is produced has not yet been noticed.

For ourselves, we do not hesitate to affirm that the zone which becomes luminous is that along which the matter mainly flows, at the moment when the change of form takes place, according to a law which we were enabled to discover in our previous researches in molecular displacements. If this first indication should be confirmed, there would be thus obtained a more exact knowledge of the mode of distortion determined by the forging, and the phenomenon which we describe would evidently form a new scientific connection between thermodynamics and the question with which we ourselves are personally occupied under the title of "Flowing of Solid Bodies."

The phenomenon ought to be the same for all metals, and we have already ventured to hazard some considerations of the particular causes of the brightness which it presented in the case of platinum, and which has not, so far as we know, been yet observed in any other forging.

The exceptional hardness of the platino-iridium, cooled to a dull red heat, requires, for an equal distortion, an amount of work at least equivalent to that of the forging of steel, and in consequence of the relative smallness of the calorific capacity of this alloy, this same work ought to be converted into calorific phenomena, more localised and more intense. Moreover, the material is more homogeneous than iron, and is notable for a kind of remarkable translucency which makes one believe that the eye can follow the shade of red to a certain depth. The effects, whatever they may be, are thus rendered more manifest, more especially as they are not accompanied by any exudation of foreign matter nor by any oxidation of the surface. All these circumstances are eminently favourable to the observation which chance permitted us to make, and which, once confirmed in the case of platinum, may certainly be renewed with other metals, although possibly in a more restricted manner than in the case of the alloy of MM. Deville and Debray.

We confine ourselves for the present to a summary indication of the principal fact, which appears to us to have a certain importance, and which consists in this appearance of luminous bands which arise from collision, and the position of which enables us to fix the precise place where is developed the heat which represents under another form the work done by motion: this fact is, perhaps, of a nature to open some new path for the researches, so carefully made, of the physicists of our epoch on all that touches on molecular mechanics and on the calorific actions which are connected with them.

The ingot of platinum has already been brought into the form of a bar with a square section of 4·50 m. in length; there will be a chance of continuing the same observations in the new operations of forging to which it will be submitted; the chance of renewing them may perhaps not again be offered.

SUBJECTS FOR PRIZES PROPOSED BY THE HAARLEM SOCIETY OF SCIENCES

THE following subjects for prizes are proposed by the Haarlem Society of Sciences:—

I. Competition of 1875, the limit of which is fixed on Jan. 1, 1875.

1. To give for ten sorts of glass of known chemical composition—(*a*) The coefficients of dilatation between 0° and (at the most) 100°, having regard to the influence of the tempering and the state of tension; (*b*) The coefficients of elasticity with exact indication of the temperatures; (*c*) The indices of refraction for at least ten points distributed over the whole extent of the spectrum, also with precise indication of the temperature.

2. Does the coefficient of dilatation of steel vary with the degree of tempering, and can we establish empirical laws on the subject of the connection between these two elements?

3. Can there be established by experiment a connection between the diffusion of liquids through porous partitions and other phenomena, such as capillarity, &c.?

4. Determine the coefficient of dilatation for at least three liquids of simple composition, according to the process by which the absolute dilatation of mercury has been established.

5. Researches are sought on the origin of sensitive organs, especially of the visual organ, among some of the inferior animals; this origin being considered, as far as possible, in relation to the conditions in which the animal is found, and the external influences to which it is subject.

6. In terrestrial magnetism, what are the periods known with sufficient accuracy, and how far have these periods been proved to be connected with cosmical or telluric phenomena?

7. New experiments and observations are wanted to clear up the following question:—How are albumenoid matters formed and removed in plants?

8. Determine exactly the density, the coefficient of dilatation, the point of fusion, the point of ebullition, the specific heat, the index of refraction, and the specific rotatory power of at least twenty organic combinations, pairs of which are isomeric and whose chemical composition is known.

9. The experiments of M. Regnault on the specific heat of certain terpenes, and those of M. Berthelot on diamylene and triamylene, having shown that the specific heat of polymeric bodies of one combination may be equal to that of the fundamental matter from which they originate, it is desired that these researches be extended to as great a number as possible of other combinations having between them the same relations, for the purpose of deciding if the observed fact may or may not be raised to the rank of a general law.

10. New researches are sought on tetraphenol and its derivatives, for the purpose of deciding on the value of the hypothesis of M. Limpricht concerning the existence of a series of aromatic matters with a nucleus composed of four atoms of carbon.

11. Give a critical sketch of experiments and observations concerning the existence of *Bacteria* in contagious diseases, followed by original researches on the same question investigated in one or more of these maladies.

12. New experiments are asked on the mode of growth of bone, of such a kind as to abolish the differences of opinion founded upon results apparently contradictory, announced in recent years by various experimenters.

13. A thorough investigation is wanted of some of the species of Linnæus, chosen from among those which present more or less of varied forms. These species ought to be wild (*spontanées*) plants, to the number of ten at least, and of twenty or more, belonging to two natural families at least, and inhabiting well-explored countries, such as Europe, the United States, &c. The author ought to discover, describe, and classify all the forms more or less distinct, and more or less hereditary, which are included in the Linnean species, being careful to intimate their habitat, their station. He ought to study their mode of fecundation, and to judge how far certain forms may be attributed to crossing. The classification of forms into species, races, varieties, and other subdivisions as may be necessary, ought to be based at once upon the external forms and on the more intimate affinities demonstrated by fecundation and grafting.

II. For competition in 1876, for which the limit is fixed on Jan. 1, 1876.

1. Exact researches are asked for concerning the dissolving power of water, and of water charged with carbonic acid, for gypsum, chalk, and dolomite, at different temperatures and pressures, and in the case of the simultaneous presence of marine salt and other common soluble salts.

2. The same is asked for silex and the most common natural silicates.

3. To submit to a new investigation the structure of the kidneys of Mammalia, specially in reference to the epithelial lining of the different parts of the renal tubes.

4. A critical examination of recent researches from which it would appear to result that the peptones of different albumenoid matters are mixtures of substances in part already known and partly yet unknown. This critical examination should be completed by personal researches.

5. To determine exactly in Weber units, the resistance of a column of mercury of one metre in length and of one square millimetre in section, at 0°.

6. To make better known, by careful experiments, the relation between the two kinds of electrical units, electro-magnetic units and electro-static units.

7. New experiments tending to determine the influence of pressure on chemical action.

The prize offered by the Society for each of these questions consists (at the choice of the competitors) either of a gold medal bearing the ordinary stamp of the Society, along with the name of the author and the date, or a sum of 150 florins. A supplementary premium of 150 florins may, moreover, be awarded if any memoir is deemed worthy of it. The memoirs sent for competition ought to be written in one of the following languages:—French, Dutch, English, Italian, Latin, or German (but not in German character). They ought to be accompanied by a sealed envelope containing the name of the author, who ought not to make himself otherwise known.

COMMON WILD FLOWERS CONSIDERED IN RELATION TO INSECTS[*]

At the close of the last century, Conrad Sprengel published a most valuable work on Flowers, in which he pointed out that their forms and colours, their scent, honey, and general structure, have reference to the visits of insects, which are of importance to Flowers in transferring the pollen from the stamens to the pistil. Sprengel's admirable work, however, did not attract the attention it deserved, and remained comparatively unknown until Mr. Darwin devoted himself to the subject. Our illustrious countryman was the first to perceive that insects are of importance to Flowers, not only in transferring the pollen from the stamens to the pistil, but in transferring it from the stamens of one flower to the pistil of another. Sprengel had, indeed, observed in more than one instance that this was the case; but he did not appreciate the importance of the fact. Mr. Darwin's remarkable memoir on Primula, to which I shall again have occasion to refer more than once, was published in 1862; in this treatise the importance of cross-fertilisation, as it may be called, was conclusively proved, and he has since illustrated the same rule by a number of researches on Orchids, Linum, Lythrum, and a variety of other plants. The new impulse thus given to the study of Flowers has been followed up in this country by Hooker, Ogle, Bennett, and other naturalists, and on the Continent by Axell, Delpino, Hildebrand, and especially by Dr. H. Müller, who has published an excellent work on the subject, bringing together the observations of others and adding to them an immense number of his own.

Everyone knows how important flowers are to insects; everyone knows that bees, butterflies, &c., derive the main part of their nourishment from the honey or pollen of flowers; but comparatively few are aware, on the other hand, how much the flowers themselves are dependent on insects.

Yet it is not too much to say, if flowers are very useful to insects, insects, on the other hand, are in many cases absolutely necessary to flowers; that if insects have been in some respects modified and adapted with a view to the acquirement of honey and pollen; flowers, on the other hand, owe their scent and colours, nay, their very existence in the present form, to insects. Not only have the brilliant colours, the smell, and the honey of flowers been gradually developed under the action of natural selection to encourage the visits of insects, but the very arrangement of the colours, the circular bands and radiating lines,[*] the form, size, and position of the petals, are arranged with reference to the visits of insects, and in such a manner as to ensure the grand object which renders these visits necessary. Thus the lines and bands by which so many flowers are ornamented have reference to the position of the honey; and it may be observed that these honey-guides are absent in night-flowers, where of course they would not show, and would therefore be useless, as, for instance, in *Lychnis vespertina*, or *Silene nutans*. Night-flowers, moreover, are generally pale; for instance, *Lychnis vespertina* is white, while *Lychnis diurna* which flowers by day is red.

That the colour of the corolla has reference to the visits of insects is well shown by the case of flowers, which—as, for instance, the ray or outside florets of *Centaurea cyanus*—have neither stamens nor pistils, and serve, therefore, exclusively to render the flower-head more conspicuous. The calyx, moreover, is usually green; but when the position of the flower is such that it is much exposed, it becomes brightly coloured, as, for instance, in the Berberry.

If it be objected to me that I am *assuming* the existence of these gradual modifications, I should reply that it is not here my purpose to discuss the doctrine of Natural Selection. I may, however, remind the reader that Mr. Darwin's theory is based on the following considerations:—1. That no two animals or plants in nature are identical in all respects. 2. That the offspring tend to inherit the peculiarities of their parents. 3. That of those which come into existence only a certain number reach maturity. 4. That those which are, on the whole, best adapted to the circumstances in which they are placed, are most likely to leave descendants.

No one of these statements is, or can be, disputed, and they seem fully to justify the conclusions which Mr. Darwin has deduced from them, though not all those which have been attributed to him by his opponents.

Now, applying these considerations to flowers, if it is an advantage to them that they should be visited by insects (and that this is so will presently be shown), then it is obvious that those flowers which, either by their larger size, or brighter colour, or sweeter scent, or greater richness in honey, are most attractive to insects, will, *ceteris paribus*, have an advantage in the struggle for existence, and be most likely to perpetuate their race.

There are, indeed, other ways in which insects may be useful to plants. Thus, a species of acacia mentioned by Mr. Belt,[†] if unprotected, is apt to be stripped of its leaves by a species of leaf-cutting ant, which uses the leaves, not directly for food, but, according to Mr. Belt, to grow mushrooms on.

The acacia, however, bears hollow thorns, and each leaflet produces honey in a crater-formed gland at the base, and a small, sweet, pear-shaped body at the tip. In consequence it is inhabited by myriads of a small ant, *Pseudomyrma bicolor*, which nests in the hollow thorns, and thus finds meat, drink, and lodging all provided for it. These ants are continually roaming over the plant, and constitute a most efficient bodyguard, not only driving off the leaf-cutting ants, but even in Mr. Belt's opinion rendering it less liable to be eaten by herbivorous mammalia.

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[*] Address by Sir John Lubbock, Bart., F.R.S., at the Belfast meeting of the British Association, August 1874.

[*] I did not realise the importance of these guiding marks until, by experiments on bees, I saw what difficulty they experience if honey, which is put out for them, is moved even slightly from its usual place.

[†] F. Müller has observed similar facts in Sta. Catharina. (NATURE, vol. x. p. 102.)

We are now, however, more immediately concerned with bees and flowers.

Many flowers close their petals during rain, which is obviously an advantage, since it prevents the honey and pollen from being spoilt or washed away. Everybody, however, has observed that even in fine weather certain flowers close at particular hours. This habit of going to sleep is surely very curious. Why should flowers do so?

In animals we can understand it; they are tired and require rest. But why should flowers sleep? Why should some flowers do so and not others? Moreover, different flowers keep different hours. The daisy opens at sunrise and closes at sunset, whence its name "day's-eye." The dandelion (*Leontodon taraxacum*) is said to open at seven and close at five, *Arenaria rubra* to be open from nine to three, *Nymphæa alba* from about seven to four: The common Mouse-ear Hawkweed (*Hieracium pilosella*) is said to waken at eight and go to sleep at two; the scarlet pimpernel (*Anagallis arvensis*) to wake at seven and close soon after two; while *Trogopogon pratensis* opens at four in the morning, and closes just before twelve, whence its English name, "John go to bed at noon." Farmers' boys in some parts are said to regulate their dinner-time by it. Other flowers, on the contrary, open in the evening.

Now, it is obvious that flowers which are fertilised by night-flying insects would derive no advantage from being open by day; and, on the other hand, that those which are fertilised by bees would gain nothing by being open at night. Nay, it would be a distinct disadvantage, because it would render them liable to be robbed of their honey and pollen, by insects which are not capable of fertilising them. I would venture to suggest, then, that the closing of flowers may have reference to the habits of insects, and it may be observed also in support of this that wind-fertilised flowers never sleep;[*] and that some of those flowers which attract insects by smell emit their scent at particular hours: thus, *Hesperis matronalis* and *Lychnis vespertina* smell in the evening, and *Orchis bifolia* is particularly sweet at night.

I now pass to the structure and modification of flowers. A perfect flower consists of (1) an outer envelope or *calyx*, sometimes tubular, sometimes consisting of separate leaves, called *sepals*; (2) an inner envelope or *corolla*, which is generally more or less coloured, and which, like the calyx, is sometimes tubular, sometimes composed of separate leaves, called *petals*; (3) of one or more *stamens*, consisting of a stalk or *filament*, and a head or *anther*, in which the pollen is produced; and (4) a *pistil*, which is situated in the centre of the flower, and consists generally of three principal parts—one or more *carpels* at the base, each containing one or more seeds; the stalk or *style*; and thirdly the *stigma*, which in many familiar instances forms a small head at the top of the style or ovary, to which the pollen must find its way in order to fertilise the flower. In some cases the stigma is sessile. Thus it will be seen that the pistil is normally surrounded by a row of stamens, and it would seem at first sight a very simple matter that the pollen of the latter should fall on the former.

This in fact does happen in many cases, and flowers which thus fertilise themselves have evidently one great advantage—few remain sterile for want of pollen. Everyone, however, who has watched flowers and has observed how assiduously they are visited by insects, will admit that these insects must often deposit on the stigma, pollen brought from other plants, generally of the same species. For it is a remarkable fact that in most cases bees confine themselves in each journey to a single species of plant, though in the case of some very nearly allied forms this is not so; for instance, it is stated on good authority that *Ranunculus acris*, *R. repens*, and *R. bulbosus* are not distinguished by the bees, or at least are visited indifferently, as is also the case with two of the species of clover, *Trifolium fragiferum* and *T. repens*. Now, it is clear, both from the structure of flowers and also from direct experiment, that as a general rule it is an advantage to flowers to be fertilised by pollen from a different plant.

I will not now enter on the large question why this confer'ilisation should be an advantage; but that it is so has been clearly proved. It has long been known that hybrids between different varieties are often remarkably strong and vigorous; Kolrenter speaks with astonishment of the "*statura portentosa*" of some plants thus raised by him; indeed, says Mr. Darwin,[*] all experimenters have been struck with the wonderful vigour, height, size, tenacity of life, precocity, and hardiness of their hybrid productions. Mr. Darwin himself, however, was, I believe, the first to show that if a flower is fertilised by pollen from a different plant, the seedlings so produced are much stronger than if the plant is fertilised by its own pollen. I have had the advantage of seeing several of these experiments, and the difference is certainly most striking. For instance, six crossed and six self-fertilised seeds of *Ipomœa purpurea* were grown in pairs on opposite sides of the same pots; the former reached a height of 7 ft., while the others were on an average only 5 ft. 4½ in. The first also flowered more profusely. It is also remarkable that in some cases plants are themselves more fertile if supplied with pollen from a different flower, a different variety, and even as it would appear in some cases, as in the Passion Flower, for instance, of a different species. Nay, in some cases it would seem that pollen has no effect whatever unless transferred to a different flower. In Pulmonaria, for instance, the pollen is said to be entirely without effect on the stigma of the same plant. Fritz Muller has made a variety of experiments on this interesting subject, which seem to show that in some cases, pollen, if placed on the stigma of the same flower, has no more effect than so much inorganic dust; while, which is perhaps even more extraordinary, in others the pollen placed on the stigma of the same flower acted on it like a poison. This he observed in several species: the flower faded and fell off; the pollen masses themselves, and the stigma in contact with them, shrivelled up, turned brown, and decayed; while other flowers on the same branch, which were left unfertilised, retained their freshness.

We will now pass to the consideration of the means by which self-fertilisation is checked, and cross-impregnation is effected, in plants. In some cases the pollen is simply wind-borne, in others it is carried by insects. These are attracted partly by the pollen itself, partly by the honey; while the bright colour and the scent serve to indicate the spot where the pollen and honey can be found. The calyx, which is not generally brightly coloured, probably serves as a protection to the honey, and tends to prevent bees and other insects from obtaining access to it by force.

In many cases self-fertilisation is prevented by the separation of the stamens and pistils, either in the place they occupy, or the time of their maturity. They are frequently situated, either in different flowers of the same plant, as in Euphorbia, or in different plants, as in the Hop; in other cases, although the stamens and pistils are situated in the same flower, they do not mature at the same time, the anthers in some cases producing their pollen before the pistil is ready to receive it, as was first observed in *Epilobium angustifolium* by Sprengel, in the year 1790;[*] while in others the reverse is the case, and the pistil, on the contrary, comes to maturity before the pollen is formed. But even when the stamens and pistils are situated in the same flower and ripen at the same time, they are sometimes so placed that it is difficult for the pollen to reach the stigma.

Moreover, it appears that if a supply of pollen from another plant is secured, it is comparatively unimportant to exclude the pollen of the plant itself, for in such cases the latter is neutralised by the more powerful effect of the former.

It is also interesting to notice that the contrivances by which cross-fertilisation is favoured, or ensured, are probably of very different geological antiquity. Thus, as Muller has pointed out,[†] the special peculiarities of the Umbelliferæ and Compositæ have been inherited respectively from the ancestral forms of those orders; those of Delphinium, Aquilegia, Linaria, and Pedicularis, from the ancestral forms of the respective genera; those of *Polygonum fagopyrum*, *P. bistorta*, *Lonicera caprifolium*, &c., from the ancestors of those species; while in *Lysimachia vulgaris*, *Rhinanthus cristagalli*, *Veronica spicata*, *Euphrasia odontites*, and *E. officinalis*, we find that differences have arisen even within the limits of one and the same species.

The transference of the pollen from one flower to another, as I have already mentioned, is effected principally, either by the wind or by insects. In the former case the flower is rarely conspicuous; indeed, Mr. Darwin finds it "an invariable rule that when a flower is fertilised by the wind it never has a gaily-coloured corolla." The conifers, grasses, birches, poplars, &c., belong to this category.

In such plants a much larger quantity of pollen is required than where the fertilisation is effected by insects. Everyone has observed the showers of yellow pollen produced by the Scotch fir. Again, it is an advantage to these plants to flower before the leaves are out, because the latter would greatly interfere with the access of the pollen to the female flower. Hence such plants as a rule flower early in the spring. Again, in such flowers the pollen is less adherent, so that it can easily be detached by the wind,[*] which would manifestly be a disadvantage in the case of most of those flowers which are fertilised by insects.

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[*] Sprengel, "Das entdeckte Geheimniss der Natur," p. 291.

[†] Animals and Plants under Domestication, ch. xvii.

[*] "Das entdeckte Geheimniss der Natur."

[†] Müller, p. 44.

Such flowers generally have the stigma more or less branched or hairy, which evidently must tend to increase their chances of catching the pollen.

It is an almost invariable rule that wind-impregnated flowers are inconspicuous, but the reverse does not hold good, and there are many flowers which, though habitually visited by insects, are not brightly coloured. In some cases flowers make up by their numbers for the want of individual conspicuousness. In others the insects are attracted by scent; indeed, as has already been mentioned, the scent, as well as the colours of flowers, has no doubt been greatly developed through natural selection, as an attraction to insects.[*] But though bright colours and strong odours are sufficient to attract the attention of insects, something more is required. Flowers, however sweet smelling or beautiful, would not be visited by insects unless they had some more substantial advantages to offer. These advantages are the pollen and the honey; though it appears that some flowers beguile insects by holding out the expectation of honey which does not really exist, just as some animals repel their enemies by resembling other species which are either dangerous or disagreeable.

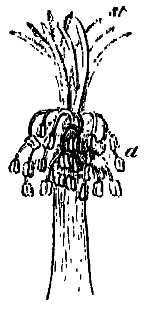


FIG. 1.

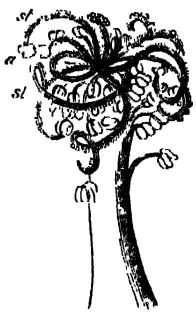


FIG. 2.

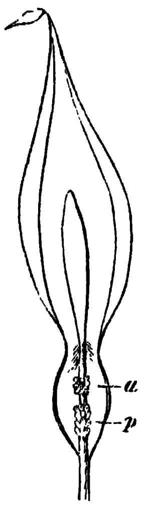
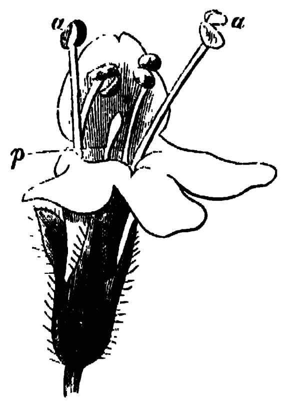


FIG. 3.



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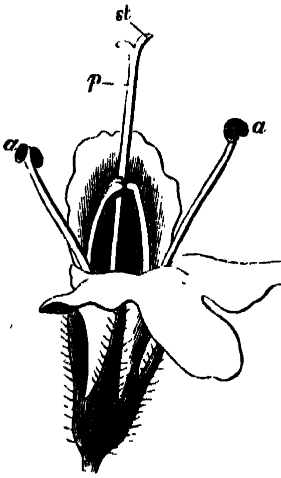

FIG. 5.

The pollen, of course, though very useful to insects, is also essential to the flower itself; but the scent and the honey, at least in their present development, are mainly useful to the plant in securing the visits of insects, and the honey also sometimes in causing the pollen to adhere to the proboscis of the insect. Among other obvious evidences that the beauty of flowers is useful in consequence of its attracting insects, we may adduce those cases in which the transference of the pollen is effected in different manners in nearly allied plants, sometimes even in different species belonging to the same genus.

Thus, *Malva sylvestris* and *Malva rotundifolia*, which grow in the same localities, and therefore must come into competition, are nevertheless nearly equally common. In both species the young flowers contain a pyramidal group of stamens which surround the as yet immature pistil, and produce a large quantity of pollen, which cannot fail to dust any insect which may visit the flower for the sake of its honey. In *Malva sylvestris* (Fig. 1), where the branches of the stigma are so arranged that the plant cannot fertilise itself, the petals are large and conspicuous, so that the plant is visited by numerous insects; while in *Malva rotundifolia* (Fig. 2), the flowers of which are comparatively small and are rarely visited by insects, the branches of the stigma are elongated and twine themselves among the stamens, so that the flower can hardly fail to fertilise itself.

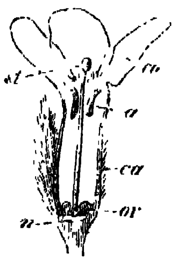

FIG. 6.

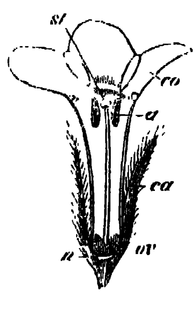

FIG. 7.

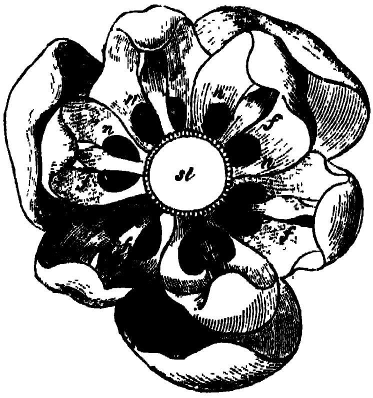

FIG. 8.

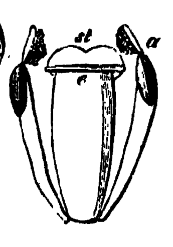

FIG. 9.

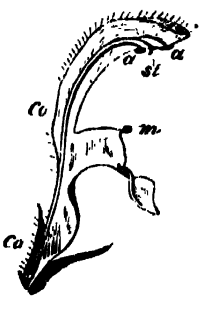

FIG. 10.

Another remarkable instance occurs in the genus Epilobium, which is, moreover, specially interesting, because in *E. angustifolium*, as I have already mentioned, the curious fact was first noticed that the pistil did not mature until the stamens had shed their pollen. *E. angustifolium* has conspicuous purplish-red flowers, in long terminal racemes, and is much frequented by insects; *E. parviflorum*, on the contrary, has small solitary flowers, and is seldom visited by insects. Now, to the former species the visits of insects are necessary, since the stamens ripen before the pistil, and the flower has consequently lost the power of self-fertilisation. In the latter, on the contrary, the stamens and pistil come to maturity at the same time, and the flower habitually fertilises itself. It is, however, no doubt sometimes crossed by the agency of insects; and indeed I am disposed to believe that this is true of all flowers which are either coloured or sweet scented. The degree in which flowers are dependent on insects differs very much, and it seems to be a general rule that in any genus where the flowers differ much in size, the largest ones are specially dependent on insects.

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[*] On the other hand, it is an advantage to wind-borne seeds to be somewhat tightly attached, because they are then only removed by a high wind which is capable of carrying them some distance.

[*] In confirmation of this it is stated that when insects are excluded, the blossoms last longer than is otherwise the case; that when flowers are once fertilised, the corolla soon drops off, its function being performed.

As already mentioned, the self-fertilisation of flowers is in other cases still more effectually guarded against by the fact that the stamens and pistils do not ripen at the same time.

In some cases the pistil ripens before the stamens. Thus the Aristolochia has a flower which consists of a long tube with a narrow opening closed by stiff hairs which point backwards, so that it much resembles an ordinary eel-trap. Small flies enter the tube in search of honey, which from the direction of the hairs they can do easily, though on the other hand, from the same cause, it is impossible for them to return. Thus they are imprisoned in the flower; gradually, however, the pistil passes maturity, the stamens ripen and shed their pollen, by which the flies get thoroughly dusted. Then the hairs of the tube shrivel up and release the prisoners, which carry the pollen to another flower.

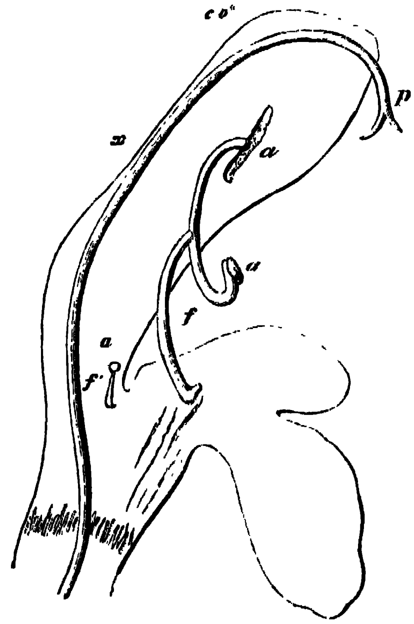

FIG. 11

Again, in the common Arum (Fig. 3), we find a somewhat similar mode of fertilisation. The well-known green leaf encloses a central pillar which supports a number of pistils near the base, and of anthers somewhat higher. Now, in this case nothing would at first sight seem easier or more natural than that the pollen from the anthers should fall on and fertilise the pistils. This, however, is not what occurs. The pistils (*p*) mature before the anthers (*a*), and by the time the pollen is shed have become incapable of fertilisation. It is impossible, therefore, that the plant should fertilise itself. Nor can the pollen be carried by wind. When it is shed it drops to the bottom of the tube, where it is so effectually sheltered that nothing short of a hurricane could dislodge it; and although Arum is common enough, still the chances against any of the pollen so dislodged being blown into the tube of another plant would be immense.

As, however, in Aristolochia, so also in Arum, small insects which, attracted by the showy central spadix, the prospect of shelter or of honey, enter the tube while the stigmas are mature, find themselves imprisoned, as the fringe of hairs, while permitting their entrance, prevents them from returning. After a while, however, the period of maturity of the stigmas is over, and each secretes a drop of honey, thus repaying the insects for their captivity. The anthers then ripen and shed their pollen, which falls on and adheres to the insects. Then the hairs gradually shrivel up and set the insects free, carrying the pollen with them, so that those which then visit another plant can hardly fail to deposit some of it on the stigmas. Sometimes more than a hundred small flies will be found in a single Arum. In these two cases there is obviously a great advantage in the fact that the stigmas arrive at maturity before the anthers. Generally, however, the advantage is the other way, and the stamens ripen before the pistil.

Of this we may take the thyme or the marjoram as an illustration. The flowers are crowded together, and as the stigmas do not come to maturity until all the anthers in the same head have shed their pollen, it is obvious that bees creeping over the flowers must transfer the pollen from the anthers of one head to the pistils of another.

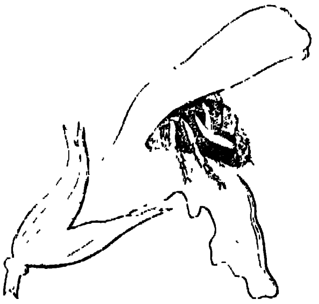

FIG. 12.

Fig. 4 represents a flower of the thyme (*Thymus serpyllum*), and shows the four ripe stamens, and the short, as yet undeveloped pistil. Fig. 5, on the contrary, represents a somewhat older flower, in which the stamens are past maturity, while the pistil, on the other hand, is considerably elongated, and is ready for the reception of the pollen.

Here it is at once obvious that insects alighting on the younger (male) flowers would dust themselves with pollen, some of which, if they subsequently alighted on an older flower, they could not fail to deposit on the stigma. It should also be mentioned that in this genus there are likewise some small flowers which contain no stamens. In some cases flowers which are first male and then female, are male on the first day of opening, female on the second. In others the period is longer. Thus Nigella, according to Sprengel, is male for six days, after which the stigma comes to maturity and lasts for three or four.*

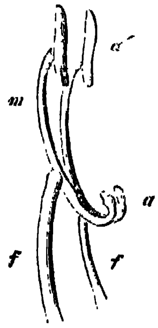

FIG. 13.

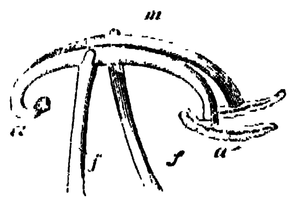

FIG. 14.

Fig. 6 represents a flower of *Myosotis versicolor*, a species often known as the Forget-me-not, when just opened. It will be observed that the pistil projects above the corolla and stamens, so that it must be first touched by any insect alighting on the flower. Gradually, however, the corolla elongates, carrying up the stamens with it, until at length they come opposite the stigma, as shown in Fig. 7. Thus, if the flower has not already been fertilised by insects, it is almost sure to fertilise itself.

I will now call attention in more detail to some of our common wild flowers, in order to show how beautifully they are adapted to profit by the visits of insects, and how the various parts are arranged so as to favour not only the transfer of pollen from one flower to another, but also its deposition on that part of the pistil which is especially prepared for its reception. Wherever the pistil projects beyond the stamens, it is obvious that a bee alighting on the flower would come in contact first with the former and subsequently with the latter. In flying from flower to flower, therefore, she would generally fertilise each with the pollen of one which had been previously visited.

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* "Das entdeckte Geheimniss der Natur," p. 287.

Fig. 8 represents the common Berberry. *f f* represent the stamens, which lie close to the petals and almost at right angles to the pistil (*s t*), as shown in the figure. The honey-glands (*n n*) are twelve in number, situated in pairs at the base of the petals, so that the honey runs down into the angle between the bases of the stamens and of the pistil. The papillary edge of the summit of the pistil (*s t*) serves as the stigma. In open flowers of this kind it is of course obvious that insects will dust themselves with the pollen and then carry it with them to other flowers. In Berberis, however, both advantages, the dusting and the cross-fertilisation, are accomplished by a very curious contrivance. The bases of the stamens are highly irritable, and when an insect touches them the stamens spring forward (Fig. 9) and strike the insect. The effect of this is not only to shed the pollen over the insect, but also in some cases to startle it and drive it away, so that it carries the pollen, thus acquired, to another flower.

In few flowers is the adaptation of the various parts to the visits of insects more clearly and beautifully shown than in the common white Dead Nettle (*Lamium album*), Fig. 10. The honey occupies the lower contracted portion of the tube (Fig. 10, *c a*), and is protected from the rain by the arched upper lip and by a thick rim of hairs. Above the narrower lower portion the tube expands and throws out a broad lip (Fig. 10, *m*), which serves as an alighting place for large bees, while the length of the narrow tube prevents the smaller species from obtaining access to the honey, which would be injurious to the flower, as it would remove the source of attraction for the bees, without effecting the object in view. At the base of the tube, moreover, there is a ring of hairs, which prevent small insects from creeping down the tube and so getting at the honey. Lamium, in fact, like so many of our other wild flowers, is especially adapted for humble-bees. They alight on the lower lip (Fig. 10, *m*), which projects at the side so as to afford them a leverage by means of which they may press the proboscis down the tube to the honey; while on the other hand the arched upper lip, in its size, form, and position, is admirably adapted not only as a protection against rain, but also to prevent the anthers (Fig. 10, *a a*) and pistil (Fig. 10, *s t*) from yielding too easily to the pressure of the insect, and thus to ensure that it presses the pollen which it has brought from other flowers against the pistil.

The stamens do not form a ring round the pistil, as is so usual. On the contrary, one stamen is absent or rudimentary, while the other four lie along the outer arch of the flower, on each side of the pistil. They are not of equal length, as is usual, but one pair is shorter than the other; sometimes the inner pair, and at others the outer pair being the longest. Now, why is this? Probably, as Dr. Ogle has suggested, because if the anthers had lain side by side, the pollen would have adhered to parts of the bee's head which do not come in contact with the stigma, and would therefore have been wasted; perhaps also partly, as he suggests, because it would have been deposited on the eyes of the bees, and might have so greatly inconvenienced them as to deter them from visiting the flower. Dr. Ogle's opinion is strengthened by the fact that there are some species, as for instance the Foxglove, in which the anthers are transverse when immature, but become longitudinal as they ripen.

But to return to the Dead Nettle. From the position of the pistil which hangs down below the anthers, the bee comes in contact with the former before touching the latter, and consequently generally deposits upon the stigma pollen from another flower. The small processes (Fig. 10, *m*) on each side of the lower lip are the rudiments of the lateral leaves with which the ancestors of the Lamium were provided. Thus, then, we see how every part of this flower, is either, like the size and shape of the arched upper lip, the relative position of the pistil and anthers, the length and narrowness of the tube, the size and position of the lower lip, the ring of hairs and the honey, adapted to ensure the transference, by bees, of pollen from one flower to another; or, like the minute lateral points, is an inheritance from more highly developed organs of ancestors. If we compare Lamium with other flowers we shall see how great a saving is effected by this beautiful adaptation. The stamens are reduced to four, the stigma almost to a point; how great a contrast with the pines and their clouds of pollen; or even with such a flower as the Nymphæa, where the visits of insects are secured, but the transference of the pollen to the stigma is, so to say, accidental. Yet the fertilisation of Lamium is not less effectually secured than in either of these.

In this flower it would appear, as already mentioned, that the pistil matures as early as the stamens, and that cross-fertilisation is obtained by the relative position of the stigma, which, as will be seen in the figure, hangs down below the stamens, so that a bee bearing pollen on its back from a previous visit to another flower would touch the pistil and transfer to it some of this pollen before coming in contact with the stamens.

In other species belonging to the same great group (Labiatæ) the same object is secured by the fact that the stamens come to maturity before the pistils have shed their pollen, and shrivelled up before the stigma is mature.

Fig. 11 represents a young flower of *Salvia officinalis** in which the stamens (*a*) are mature, but not the pistil (*p*), which moreover from its position is untouched by bees visiting the flower. The anthers as they shed their pollen gradually shrivel up; while on the other hand the pistil increases in length and curves downwards, until it assumes such a position that it must come in contact with any bee visiting the flower, and would touch just that part of the back on which pollen would be deposited by a younger flower. In this manner self-fertilisation is effectually provided against. There are, however, several other points in which *S. officinalis* differs greatly from the species last described. The general form of the flower indeed is very similar. We find again, as generally in the Labiates, the corolla has the lower lip adapted as an alighting board for insects, while the arched upper lip covers and protects the stamens and pistils.

In the present species, however, the back of the upper lip shows a deep arch at the part *x*, and the front portion of the lip, containing the stamens, is loftier than in Lamium, and does not therefore come in contact with the back of the bee. In evident correlation with this arrangement we find a very remarkable difference in the stamens (Figs. 13 and 14). Two of the stamens are minute and rudimentary. In the other pair the two anther cells (Fig. 14, *a a*), instead of being as usual close together, are separated by a long connection. Moreover, the lower anther cell contains very little pollen, sometimes indeed none at all. This portion of the stamen, as shown in Fig. 13, hangs down and partially stops up the mouth of the corolla tube. When, however, a bee thrusts its head into the tube in search of the honey, this part of the stamen is pushed into the arch, the connectives of the two large stamens revolve on their axis, and consequently the fertile anther cells are brought down on to the back of the bee, as shown in Fig. 12.

(*To be continued.*)

NOTES

THE German Government has determined upon the erection of a Sun Observatory ("*Sonnen-Warte*") upon a large scale at Potsdam. Drs. Spoerer and Vogel have already been appointed to undertake the telescopic and spectroscopic observations, and the directorship has been offered to Prof. Kirchhoff, who, however, has declined it, as he is unwilling to leave Heidelberg.

THE International Congress of Orientalists was opened in London on Monday, by an address from Dr. Birch. We hope to give an account of the proceedings in our next number.

WE are glad to see that a contemporary not specially devoted to science—the *Morning Post*—in an article on Dr. Hooker's address at Belfast, points out to its readers that the majority of the observations referred to could be made "by any intelligent person without any scientific training," and expresses a hope that "people who have the opportunities for cultivating, and leisure for observing, will make collections of plants . . . . and add to our stock of knowledge." At the same time it suggested these as interesting subjects for observation:—"How much can plants eat in twenty-four hours? When do they eat most? Under what conditions of weather? &c. Indeed, the whole field is one that is almost unexplored." May this hint, which will reach many who are not readers of scientific papers, not be without result! We would draw attention to the fact that plants of *Drosera rotundifolia* are advertised for sale at ninepence each, and we hope that before long some enterprising dealer may make a speciality of all known carnivorous plants for suitable observations.

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* The *Popular Science Review* for July 1869 contains a very clear and interesting paper by Dr. Ogle on this genus.

AT the Botanic Garden, Oxford, the Mexican *Dasylirion arcotrichum* recently threw-up a flower stem which, when 12 ft. high, grew at the rate of six inches in twenty-four hours. The *Nelumbium luteum* (the sacred bean) is reported this season as producing perfect seeds.

AN *Annuaire de l'Horticulture Belge* is announced as soon to appear.

THE last number of the *Gardener's Chronicle* gives a drawing of four lopped elms growing near Datchet, the tops of which have naturally grown with the outline of a horse.

THE Academy of Sciences in Copenhagen announces the subject for a prize essay, to be addressed to it through its secretary by the end of October 1875. It desires a memoir that shall collect in chronological order the various determinations of constant quantities that have been used in spherical and theoretical astronomy from the time of the Ptolemies down to the end of the eighteenth century. It will not be necessary to submit to any critical discussion the intrinsic value of the various constants, but simply to give them in as complete a manner as possible. Special researches respecting the proper motions of stars and parallaxes of stars will be excluded, as also will be those relating to the satellites of the exterior planets, and the elements of orbits of comets. It is desired principally to obtain a complete collection of those numbers that have served as the basis of earlier astronomical researches. The memoir may be written in either Latin, French, German, Swedish, or English; and the medal to be awarded will be of gold, of the value of 320 Danish crowns.

PROF. SILVESTRI reports that a transversal fissure about a mile long has appeared on the northern side of Mount Etna. Twenty fresh craters situated upon one long line have been thrown up. The first crater opened forms a cone 75 ft. high. Prof. Silvestri believes that the force of the eruption is at present spent, and that only a few slight earthquake shocks will now be felt.

M. N. RAUÏS, Assistant Secretary of the Belgian Royal Academy of Sciences (Brussels), proposes to publish a work having for its title "Dictionnaire universel des académies, sociétés savantes, observatoires, universités, musées, archives, bibliothèques, jardins botaniques," &c.,—a methodical catalogue of all establishments which contribute to the progress of science, letters, and the arts. M. Rauïs, to enable him to carry out his praiseworthy scheme, requests the managing officials of institutions of the kind indicated to furnish him with the needful information in the form indicated by the following questions:—1. Title of the establishment. 2. Date of foundation, creation, &c. 3. Its aim. 4. Titles of the directorate. 5. Seat of the Institution, with its exact address. 6. Meetings, prizes, &c. 7. Does the establishment possess a library, archives, museum, cabinet of medals or antiquities, observatories, laboratories? 8. Publications:—Number and nature (bulletin, reviews, annals or memoirs); number of volumes published from the commencement; the easiest way of procuring these publications, whether by purchase or exchange. 9. All other useful information not comprised in the preceding questions. We hope all our British scientific institutions, societies, and clubs, will aid M. Rauïs in his important undertaking.

AN exhibition of photographs, &c., in connection with the Photographic Society will be opened on October 13, at the Suffolk Street Gallery. Specimens will be received up to October 7. We have on former occasions pointed out that photography has a scientific as well as a purely artistic interest, and the present opportunity should not be allowed to pass without illustrations of what photography has done to advance pure science. Mr. John Spiller, F.C.S., has been elected President, and Mr. R. J. Friswell, F.C.S., Hon. Sec. of the Society, so that the interest of science will have a good chance of being in future attended to.

WE have received the prospectus of the Owens College School of Medicine for Session 1874–5, the professorate of which has recently been completed by the appointment of Dr. M. Watson to the chair of Anatomy. The new buildings will be opened by Prof. Huxley, F.R.S., on Friday, Oct. 2, at 3 P.M.

THE Exhibition of useful and noxious insects in Paris, which we announced (vol. x. p. 295), was opened last week in the Tuileries Gardens, and promises to be highly interesting and useful.

PROF. VON RATH, of Bonn, in *Poggendorff*, describes under the name *Foresite* a new mineral of the Zeolite family, from the granite of Elba. It is named in honour of its discoverer, Sig. Foresi, of Portoferrajo, in Elba, who found it in druses which were covered with felspar, oligoclase, quartz, lithia, and tourmaline, on which, along with Desmin [stilbite] and Stilbite [Heulandite] it forms incrustations. Foresite belongs to the prismatic system; has a similar appearance to Desmin, with surfaces bright as mother-of-pearl. The angular measurements, like the faces, indicate that it is isomorphous with Desmin. Its water, which amounts to 15·31 per cent., is entirely driven off at a red heat under the blowpipe. It decomposes with difficulty in hydrochloric acid, and its silica does not gelatinise. A mean of three analyses shows it to consist of—

Silica	49·96
Alumina	27·40
Lime	5·47
Magnesia	·40
Potash	·77
Soda	1·38
Water	15·07
	100·45

Von Rath regards its chemical formula as—

$$Na_2O,\ 3CaO,\ 8Al_2O_3,\ 24SiO_2,\ 24H_2O,$$

and thus it makes a further approximation to Desmin. It differs from all known Zeolites in the small proportion of lime to alumina and silica.

AN International Exhibition is to be opened at Chili on Sept. 16, 1875.

THERE has been started at Mevagissey, Cornwall, a manufactory of "Cornish sardines," the sardines being pilchards preserved in oil, immense quantities of which have hitherto been used as manure, or returned to the sea as of no use. We believe these Cornish sardines are at least equal to the sardines commonly imported into this country.

THE *Times* Alexandria correspondent, under date Sept. 6, states that Mr. H. M. Stanley passed through Egypt a few days previously on his way to Zanzibar. An ingeniously constructed boat, built for Mr. Stanley's expedition, was recently tried on the Thames.

WE have received the programme of the many-sided Birmingham and Midland Institute for 1874–75. Sir John Lubbock, Bart., F.R.S., delivers the inaugural address on Nov. 5, and among the other special lectures announced are two on "Cor l

Animals and Coral Islands," by Prof. W. C. Williamson, F.R.S.; "Assyrian Mythology," by Mr. George Smith; two on "The Education of the People," by Prof. W. K. Clifford; "Vitality in Men and in Races," by Dr. B. W. Richardson, F.R.S.; "A Night at Lord Rosse's Telescope," and "The Pendulum," by Prof. Ball, F.R.S.

THE following candidates have been successful in obtaining Royal Exhibitions of 50*l*. per annum, each for three years, and free admission to the course of instruction at the following institutions:—(1) To the Royal School of Mines, Jermyn Street, London: Charles W. Folkard, Lawrence J. Whalley, Alfred N. Pearson. (2) To the Royal College of Science, Dublin: Thomas Bayley, William Fream, Archibald N. McAlpine.

MR. RAMSAY WRIGHT, M.A., B.Sc., Assistant to the Professor of Natural History, Edinburgh University, has been appointed to the Chair of Natural History, University College, Toronto. Mr. Wright succeeds Prof. Alleyne Nicholson, now of the Newcastle College of Science.

PROF. E. S. HOLDEN, U.S. Navy, forwards us a letter from Mr. H. G. Wright, dated San Bernardino, Cal., Aug. 2, 1874, describing a small lake or pond in New Hampshire having two outlets, and with which he has been perfectly familiar from boyhood. "Neither of the outlets," the writer states, "ever dries up, and each of them discharges more water than enters through the only visible feeder. The pond covers, say, fifteen acres; it is shallow, with muddy bottom, with boulders in places, the surrounding land being largely made up of granite ledges and boulders. The outlets are at opposite ends of the pond—one descending rapidly 150 feet soon after leaving the pond, the other passing through a boggy swamp and then a meadow, after which it also descends rapidly. The only feeder is very small, and quite dries up in summer."

UNDER the title of "Society for the Publication of Tracts relating to the History and the Geography of the Latin East," an association has been formed in France to supplement the work of the Academy of Inscriptions. Notwithstanding the labours of the latter body, there still exists in the public depositories of various European countries, a large mass of unedited materials relating to the "Latin East,"—the kingdoms of Jerusalem, Cyprus, and Armenia, the principalities of Antioch and Achaia, and the Latin Empire of Constantinople. It is for the purpose of unearthing and publishing such material that the French society has been formed. It will be composed of forty titular members and 350 subscribing associates; from among the former a committee of publication will be selected, and the members of both classes may be either French or foreign. Two volumes will be published annually, along with a phototypographic reproduction of very rare or unique matter; to the latter titular members alone are entitled. The collection will be entitled "Bibliothèque de l'Orient Latin," and will consist of a Historic Series, a Geographical Series, and a Poetical Series. They will be published after the style of the "Chronicles and Memorials of Great Britain." Titular members pay fifty francs a year, and subscribers only fifteen.

THE additions to the Zoological Society's Gardens during the past week include a Serval (*Felis serval*) from West Africa, presented by Mr. Spencer Shield; a Cinereous Sea Eagle (*Haliaëtus albicilla*) from Norway, presented by Mr. W. J. Sadler; two Peregrine Falcons (*Falco peregrinus*) from Europe, presented by Mr. Herbert Wood; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. P. T. Wharton; a Crested Pigeon (*Ocyphaps lophotes*), two Graceful Ground Doves (*Geopelia cuneata*), hatched in the Gardens; two Green Fruit Pigeons (*Carpophaga sylvatica*) deposited.

NOTES ON THE NEW EDITION OF MR. DARWIN'S WORK ON THE STRUCTURE AND DISTRIBUTION OF CORAL REEFS (1874.)

MR. DARWIN, in the new and much improved edition of his work on Coral Reefs, mentions some points in the subject, on which he still finds reason to differ from the writer. I think that with regard to one or two of these points he has not fully understood my views; and, as to the others, that the arguments and facts which I have brought out have not received all the consideration they may deserve. A review of some statements in his work may, therefore, be profitable. I follow the order of his criticisms as briefly stated in the first half of his Preface.

I. The second sentence of the Preface is as follows:—

"In this work [Dana's Corals and Coral Reefs] he [the author] justly says that I have not laid sufficient weight on the mean temperature of the sea in determining the distribution of coral reefs; but neither a low temperature nor the presence of mud-banks accounts, as it appears to me, for the absence of coral reefs throughout certain areas; and we must look to some more recondite cause."

The first two clauses of this sentence are true—the *but* between them being removed, as it may lead some readers to suppose the alternative mine. Yet Mr. Darwin's work does not show that even now he appreciates the influence of oceanic temperature on the distribution of coral reefs. In his discussions on the distribution of reefs, and the causes limiting the same, this agency, the chiefest with marine life, both for depth and surface, according to all zoologists, is scarcely mentioned. There is one allusion to the subject on page 81. Mr. Darwin says: "I at first attributed this absence of reefs on the coasts of Peru and of the Galapagos Islands to the coldness of the currents from the south, but the Gulf of Panama is one of the hottest pelagic districts in the world;" and a note is added, giving some sea temperatures of the region referred to. Thus the cause is set aside even for the seas along the Peruvian coast, although the mean winter temperature of the water there is lower than exists in any reef region in the world, and is therefore sufficient of itself to exclude reefs. The fact that there are only small patches at Panama, where the temperature is tropical, does not annul the fact that the seas of Peru and the Galapagos are too cold for corals. Where temperature excludes, there is no use in discussing other unfavourable conditions.

The causes limiting the growth and distribution of reef-making corals and coral reefs, which I have discussed and applied in my work, are *seven* in number:—

(1.) Marine temperature.

(2.) Fresh and impure waters from the entrance of large rivers and muddy bottoms.

(3.) Deposition of sediment borne by rapid tidal currents.

(4.) The depth of water along coasts exceeding 100 feet, that is, exceeding the depth to which reef-corals may grow—a common condition along bold coasts, and often explaining, as I have found, the contrasts between the reef-bordered and open coasts of the same island.

(5.) Exposure to the heat of submarine volcanic eruptions (pp. 299, 317).

(6.) The progressing coral-island subsidence too rapid for the polyps to keep the reef well at the surface, if at all (p. 270): which cause may lead, in atoll seas, to very narrow fringing reefs; to small sizes in coral atolls, and a more or less complete obliteration of the lagoon; and to a submerging of the coral island beneath the surface; or finally, to a complete disappearance of the island (pp. 332, 369).

(7.) The direction and temperature of oceanic currents (p. 112): this cause accounting for the non-distribution of Central Pacific species of corals to the Panama coast, and the paucity of species there, with the absence of the large Astræa group and the Madrepores.

On this last point I say in explanation, on page 112: "Owing to the cold oceanic currents of the eastern border of the Pacific—one of which, that up the South American coast, is so strong and chilling as to push the southern isocryme [the line passing through points of equal mean oceanic temperature for the coldest month of the year] of 68°, the coral sea boundary, even beyond the Galapagos, and north of the equator—the coral-reef sea, just east of Panama, is narrowed to 20°, which is 36° less of width than it has in mid-ocean; and this suggests that these currents, by their temperature, as well as by *their usual westward direction*, have proved an obstacle to the transfer of mid-ocean species to the Panama coast." For the same reason the transfer of corals —warm-water species—from the West Indies or the Bermudas, eastward, to *Western Africa*, is impossible. The width of the coral reef region on the African side of the Atlantic is only 15°, while it is 48° toward the American coast, and the tropical current is *eastward*.

A proper understanding of the action of the various causes nfluencing the growth and distribution of polyps and reefs, which have been mentioned in the preceding paragraphs, may leave much less than has been imagined for that "more recondite cause."

I did not think to include among the causes a too rapid *upward* change of level—on which Mr. Darwin lays much stress. But I recognised the fact that when a rise, like that which has occurred at the island of Oahu [putting an extended range of reef hirty feet out of water] takes place, and so divides the area of eef into an elevated and non-elevated portion, the latter will be, n this account, narrower than it would have been had the land een stationary. But the cause does not appear to me to have ery many examples.

II. The third sentence of the Preface reads thus :—

"Professor Dana also insists that volcanic action prevents the rowth of coral reefs much more effectually than I had supposed ; ut how the heat or poisonous exhalations from a volcano can fect the whole circumference of a large island is not clear." And this is followed by the remark : "Nor does this fact, if lly established, falsify my generalisation that volcanoes in a state action are not found within the area of subsidence, whilst they e often present within those of elevation."

In my discussion of this subject I have attributed the destrucon here referred to about islands of active, or recently active, olcanoes, not to aerial eruptions, as might be suspected from Mr. arwin's words, but to *submarine* ; and I happen to have said othing about "exhalations." I have drawn my conclusions specially from four examples (pp. 302, 305, 306) : the island of Hawaii (Sandwich Islands), about which recent eruptions, and partly submarine, have taken place on the east, south-east, south, nd west slopes of the island, or through more than half of its ircumference ; Savaii, the largest of the Samoan or Navigator slands, and the last of the group to become extinct, as its lava treams show ; the eastern half of Maui, whose great crater must have been recently in action, while the western half bears he fullest evidence of long extinction ; and the northern extremity of the Ladrones. I state that reefs often occur on avoured parts of even such volcanic islands, as they well might if submarine eruptions were the cause, and I mention examples ; hus agreeing with Mr. Darwin's criticism that "the existence of reefs, though scantily developed, and, according to Dana, confined to one part of Hawaii, shows that recent volcanic action does not prevent their growth." My statement about that Hawaiian reef is worded thus : "the only spot of reef *seen* by us was a submerged patch off the southern cape of Hilo Bay." Mr. Darwin cites an observation with regard to the occurrence also of reefs on the northern coast of Hawaii, which accords precisely with the principle I have laid down, since the northern part of the island is, as I state in my Geological Report of the island, that which was earliest extinct, and is oldest in all its features, and therefore that which would not have been reached by the submarine eruptions. The western peninsula of Maui, or the old part, has its coral reefs, while the eastern, or part recently active, has almost none. Savaii, in like manner, has coral reefs on its western and northern shores, while elsewhere without them.

I failed to find evidence in the case of either of these volcanic regions that they are situated within areas of elevation rather than subsidence. *Only ten miles* west of Savaii lies the large island of Upolu, having very extensive reefs—on some parts of the north side three-fourths of a mile wide ; and it has not seemed safe to conclude that, while Upolu thus bears evidence of no movement or of but little subsidence, Savaii was one of elevation ; or that the north and west sides of Savaii have differed in change of level from the rest of the island. In the island of Maui, having reefs on its old western half, it can hardly be that the eastern peninsula has changed its level quite independently of the western. In the near group of the Ladrones the active volcanoes are at the north end ; the islands of the group are very small at that end, without coral reefs, while large at the other, and with broad reefs. One of them, Assumption Island, near which our Expedition passed, is only a small, steep, cinder cone, the vent of a submerged volcanic mountain. Such facts afford, therefore, some reason for my statement that the Ladrones appear to have undergone their greatest subsidence at the northern extremity of the range ; and no observations yet made suggest the contrary view.

The general proposition, that active volcanoes are absent from areas of subsidence, appears to me to need better proof than it has received. As regards the Pacific Ocean, I have found nothing to sustain it. The subsidence of the coral island area of the ocean was one of so vast extent—the breadth 4,000 miles, according to Mr. Darwin—that the sinking could have been no obstacle to the existence and contemporaneous working of volcanoes.

III. The next point in the Preface is a right correction of a misunderstanding on my part of one of Mr. Darwin's statements. It says : "Professor Dana apparently supposes (p. 320) that I look at fringing reefs as a proof of the recent elevation of the land, but I have expressly stated that such reefs, as a general rule, indicate that the land has either long remained at the same level, or has been recently elevated. Nevertheless, from upraised recent remains having been found in a large number of cases on coasts which are fringed by coral reefs, it appears to me that, of these two alternatives, recent elevation has been much more frequent than a stationary condition."

When my work passes to a second edition, I shall make the needed correction.

But I still hold that, while barrier reefs, as Mr. Darwin urges, are proofs of subsidence, small or fringing reefs are in themselves no certain evidence of a stationary level, and are often evidence of subsidence, even a greater subsidence than is implied by barrier reefs. I have already stated that one cause limiting distribution of reefs is bold shores, a wall of rock of even a hundred and fifty feet producing a complete exclusion. If Tahiti were to subside two thousand feet, it would be an island of precipitous shores all around, and with deep indentations, like the Marquesas, instead of one with broad shore planes. Such bold shores are evidence of subsidence ; and as only very small reefs, if any, could find footing about such an island, the narrow reef would be another consequence of the subsidence, and no evidence of a stationary condition. Again, the gradual sinking of an atoll, like the Gambier group, or of a Tahiti with its barrier reefs, at a rate a little fast for the growing corals, would necessarily contract the reef region, reduce the barrier reefs of a Tahiti to narrow fringing reefs ; and make an atoll, however large, a small atoll with the reef-border narrow and the lagoon perhaps obliterated. An atoll thus reduced to a sand-bank is an example of the effects of subsidence, and affords no evidence of elevation or of a long stationary condition of the region : and the same may be true of a region of narrow fringing reefs. I landed on two of the small coral islands of the equatorial Pacific which are in just the condition here described ; and my book contains descriptions of others from a good observer—J. D. Hague—who resided on them several months "for the purpose of studying the character and formation of the guano deposits." I found the depression of the old lagoon, in one case partly, in the other wholly, dry ; and I found also that the living reefs around were narrow. Mr. Darwin inclines to regard islands of this kind as either evidence of no movement, or, of elevation. On the contrary, since the coral islands of the South Pacific diminish in size toward the region of these small islands, and since the region just beyond, to the north and north-east, is free from islands, and since all the features are such as would come to them from a continuation of the coral-island subsidence to its nearly fatal end, I believe still that I was right in considering the ocean bottom in this part to have undergone a general subsidence greater than that to the south, south-west, and west, where the atolls and barrier reefs are large.

Again, if submarine eruptions are destructive, narrow reefs may exist about volcanic islands that are undergoing a subsidence. Making a reef is slow work ; and, judging from the eruptions of the present century about Hawaii, reefs would have had a poor chance in the past to form, except along the coasts that were out of reach of the submarine action.

With so many causes for the existence of narrow or fringing reefs, or of small patches of corals, it is assuredly unsafe to make them, without other corroborating testimony, evidence of a stationary condition of a region, or of an elevating movement rather than a subsiding.

IV. The next point in the Preface is stated as follows :—

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* His article is contained in the *American Journal of Science*, 2nd series, xxxiv. 224 ; 1862.

"Prof. Dana further believes that many of the lagoon islands in the Paumotu or Low Archipelago and elsewhere have recently been elevated to a height of a few feet [elsewhere stated, two or three feet] although formed during a period of subsidence; but I shall endeavour to show, in the sixth chapter of the present edition, that lagoon islands which have long remained at a stationary level often present the false appearance of having been slightly elevated." And, in the body of the work, where the subject is taken up (p. 168), Mr. Darwin remarks that my belief in these small local elevations is grounded chiefly on the shells of Tridacnas embedded, in their living positions, in the coral rock at heights where they could not now survive.

The catalogue of such elevations which I give (p. 345)—after a dozen pages devoted to a discussion of the evidence respecting each—is as follows:—

Paumotu Archipelago	Honden	2 or 3
,, ,,	Clermont Tonnerre	2 or 3
,, ,,	Nairsa or Dean's	6
,, ,,	Elizabeth	80
,, ,,	Metia or Aurora	250
,, ,,	Ducie's	1 or 2?
Tahitian Group	Tahiti	0?
,, ,,	Bolabola	?
Hervey and Rurutu Groups	Atiu	12?
,, ,, ,,	Mauke	somewhat elevated.
,, ,, ,,	Mitiaro	,, ,,
,, ,, ,,	Mangaia	300
,, ,, ,,	Rurutu	150
,, ,, ,,	Remaining Islands	0?
Tongan Group	Eua	300?
,, ,,	Tongatabu	50 to 60
,, ,,	Namuka and the Hapaii	25
,, ,,	Vavau	100
Savage Island		100
Samoan or Navigator Islands		0
North of Samoa	Swain's	2 or 3
,, ,,	Fakaafo, or Bowditch	3
,, ,,	Oatafu, or Duke of York's	2 or 3
Scattered Equatorial Islands	Washington	2 or 3?
,, ,, ,,	Christmas	?
,, ,, ,,	Jarvis's	8 or 10
,, ,, ,,	Malden's	25 or 30
,, ,, ,,	Starbuck's	?
,, ,, ,,	Penrhyn's	35
,, ,, ,,	Flint's and Staver's	?
,, ,, ,,	Baker's	5 or 6
,, ,, ,,	Howland's	?
,, ,, ,,	Phœnix and McKean's	0
,, ,, ,,	Enderbury's	2 or 3?
,, ,, ,,	Newmarket	6 or 8?
,, ,, ,,	Gardner's, Hull's, Sydney, Birnie's	0?
Feejee Islands	Viti Levu and Vanua Levu, Ovalau	5 or 6?
	Eastern Islands	0?
North of Feejees	Horne, Wallis, Ellice, Depeyster	0?
Sandwich Islands	Kauai	1 or 2
,, ,,	Oahu	25 or 30
,, ,,	Molokai	300
,, ,,	Maui	12
Gilbert Islands	Taputeuea	2 or 3
,, ,,	Nonouti, Kuria, Maiana, and Tarawa	3 or more.
,, ,,	Apamama	5
,, ,,	Apaiang or Charlotte.	6 or 7
,, ,,	Marakei	3 or more.
,, ,,	Makin	?
Carolines	McAskill's	60
Ladrones	Guam	600
,,	Rota	600
Feis		90
Pelews		0?
New Hebrides, New Caledonia, Salomon Islands		none ascertained.

Of the cases of elevation here included, in *only two* are shells of Tridacnas mentioned; these are Honden Island and Clermont Tonnerre, in the Paumotus. It is not necessary to go over the evidence for the several cases, as it is stated at length in my work.

Mr. Darwin, while speaking on the subject of local elevations, on p. 176, and discussing the facts as regards the Samoan (Navigator) Islands, adds that "in another place he [Mr. Dana] says (p. 326) that some of the [Samoan] islands have probably subsided." From the remark the reader would infer that this Samoan subsidence was a local subsidence, like the elevations under consideration. But in fact my statement is in a chapter on the general coral-island subsidence, and, on the page there referred to (p. 326), I cite Mr. Darwin's conclusions as to the Gambier Island subsidence, and put with it my own from the width of the reefs of Upolu and other reef-bordered islands. At the same place I allude to the greater subsidence of Tutuila—the island next to the west, as proved by its bold shores and small reefs.

In conclusion, if I differ widely, for the reasons above stated, from Mr. Darwin, as to the limits of the areas of subsidence and elevation in the Pacific, and believe that the new edition of his work shows little appreciation of some of the most important causes that have limited the distribution of coral reefs, I have, as I say in my work, the fullest satisfaction in his theory for the origin of atoll and barrier forms of reefs, and in the array of facts of his own observation which illustrate the growth of coral formations.

JAMES D. DANA

THE BRITISH ASSOCIATION

REPORTS

Report of the Committee on the Teaching of Physics in Schools, by Prof. G. C. Foster.

In view of the very great diversities in almost all respects of the conditions under which the work of different schools has to be carried on, the committee considered that in any suggestions or recommendations that they might make it would be impossible for them, with any advantage, to attempt to enter into details. They have therefore, in the recommendations which they have agreed upon, endeavoured to keep in view certain principles which they regard as of fundamental importance, without attempting to prescribe any particular way of carrying them out in practice.

They have assumed as a point not requiring further discussion, that the object to be attained by introducing the teaching of physics into general school-work is the mental training and discipline which pupils acquire through studying the methods whereby the conclusions of physical science have been established. They are however of opinion that the first and one of the most serious obstacles in the way of the successful teaching of the subject is the absence from the pupil's mind of a firm and clear grasp of the concrete facts and phenomena forming the basis of the reasoning processes they are called upon to study.

They therefore think it of the utmost importance that the first teaching of all branches of physics should be, as far as possible, of an experimental kind. Whenever circumstances admit of it, the experiments should be made by the pupils themselves and not merely by the teacher, and though it may not be needful for every pupil to go through every experiment, the committee think it essential that every pupil should at least make some experiments himself. For the same reasons they consider that the study of text-books should be entirely subordinate to attendance at experimental demonstrations or lectures, in order that the pupil's first impressions may be got directly from the things themselves, and not from what is said about them. They do not suppose that it is possible in elementary teaching entirely to do without the use of text-books, but they think they ought to be used for reviewing the matter of previous experimental lessons rather than in preparing for such lessons that are to follow.

With regard to the order in which the different branches of physics can be discussed with greatest advantage, considering that all explanation of physical phenomena consists in the reference of them to mechanical causes, and that therefore all reasoning about such phenomena leads directly to the discussion of mechanical principles, the committee are of opinion that it is desirable that the school teaching of physics should begin with a course of elementary mechanics, including hydrostatics and pneumatics, treated from a purely experimental point of view. The committee do not overlook the fact that very little progress can be made in theoretical mechanics without considerable familiarity with the processes of mathematics, but they believe that by making constant appeal to experimental proofs the study of mechanics may be profitably begun by boys who have acquired a fair knowledge of arithmetic, including decimals and proportion, and as much geometry as is equivalent to the first book of Euclid. They believe that it will be found sufficient to impart such further geometrical knowledge as may be required, such, for instance, as a knowledge of the properties of similar triangles—in the first instance, during the course of instruction in mechanics.

In reference to the order in which the other departments of physics should be studied, the committee do not think it possible to prescribe any one order that is necessarily preferable to others that might be adopted; but they consider it desirable that priority should be given to those branches in which the ideas encountered at the outset of the study are most easily apprehended, and illustrations of which are most frequently met with in common experience. On these grounds they suggest that the elementary parts of the science of heat may advantageously follow mechanics; that elementary optics (including the laws of reflexion and refraction, the formation of images, colour, chromatic dispersion, and the construction of the simple optical instruments) should come next, and afterwards the elements of electricity and magnetism.[*] When it is found possible to include in the work of a school a fuller or more advanced course of physics than that here indicated, the committee are of opinion that the discretion of the master, guided by the circumstances of the case, will best decide in what direction the extension shall take place; they suggest, however, that an early place in the course should be given to elementary astronomy, both because it furnishes the grandest and most perfect examples of the application of dynamical principles, and because it promotes an intelligent interest in phenomena which, in the most superficial aspects at least, cannot fail to arrest the attention and familiarise the mind with the wide range of application of physical laws.

The committee are strongly of opinion that no very beneficial results can be looked for from the general introduction of physics into school teaching, unless those who undertake to teach it have themselves made it the subject of serious and continued study and have also given special attention to the best methods of imparting instruction in it. They therefore suggest that with a view to affording facilities to persons desirous of becoming teachers of physics for familiarising themselves with the most efficient methods and gaining experience in them, the Council of the British Association should invite the leading teachers of physics in the universities, colleges, and schools of the United Kingdom, to allow such persons, under suitable regulation, to be present at the instructions given by them, and, when practicable, to act as temporary assistants. The committee do not hereby mean that aspirants to the teaching function should be encouraged to drop in at random to hear any lecture by any established teacher who happened to be within reach; the kind of attendance they have in view would be systematic and continued for not less than some moderate period of time, such perhaps as two or three months, agreed upon at starting.

They believe that the benefits which might result from the adoption of such a plan are very great; the advantages to those who might avail themselves of it are obvious, and while teachers of established success would have a chance of spreading widely their methods of instruction, and in fact of founding schools of discipline, the stimulus to exertion afforded by the consciousness that they were being watched by men who were preparing themselves to occupy positions similar to their own would be of the most efficient kind.

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[*] It should be stated that one member of the committee did not approve of the order of the subjects suggested in the text.

SECTIONAL PROCEEDINGS

SECTION A—MATHEMATICS

On the application of Kirchhoff's Rules for Electric Circuits to the solution of a Geometrical Problem, by Prof. Clerk-Maxwell, F.R.S.

The geometrical problem is as follows:—Let it be required to arrange a system of points so that the straight lines joining them into rows and columns shall form a network such that the sum of the squares of all these joining lines shall be a minimum, the first and last points of the first and last row being any four points given in space. The network may be regarded as a kind of extensible surface, each thread of which has a tension in each segment proportioned to the length of the segment. The problem is thus expressed as a statical problem, but the direct solution would involve the consideration of a large number of unknown quantities. This number may be greatly reduced by means of the analogy between this problem and the electrical problem of determining the currents and potentials in the case of a network of wire having square meshes, one corner of which is kept at a unit potential, while that of the other three corners is zero. This problem having been solved by Kirchhoff's method, the position of any point P in the geometrical problem with reference to the given points A B C D, is by finding the values of the potentials p_a p_b p_c p_d of the corresponding point in the electric problem when the corners a b c d respectively are those of unit potential. The position of P is then found by supposing p_a p_b p_c p_d placed at A B C D respectively, and determining P as the centre of gravity of the four masses.

On the Apparent Connection between Sun-spot and Atmospheric Ozone, by T. Moffat, M.D., F.G.S., &c.

At the last meeting of the British Association, Mr. Smith, of Birmingham, gave me a record of the number of new groups of sun-spots which appeared in each year for a number of years, and he asked me to compare the mean daily quantity of ozone in each year with the number of groups. I have done so, and in the following table I have given the mean daily quantity of ozone for nineteen years (1851-1869) with the number of groups.

Years.	Total number of new groups of spots which have appeared in each year.	Mean daily quantity of ozone.	Maximum actual number of groups.	Mean of ozone.
1851	141	2·6	141	2·6
1852	125	1·9	125	1·9
1853	91	2·0	202	1·5
1854	67	3·4	205	2·2
1855	28	·8	211	2·1
1856	34	·7	204	1·9
1857	92	1·1	166	2·6
1858	202	1·5	124	3·5
1859	205	2·2	130	2·0
1860	211	2·1	101	1·7
1861	204	1·9	224	1·9
			Mean, 166	Mean, 2·2
			Minimum.	Mean of ozone.
1862	166	2·6	91	2·0
1863	124	3·5	67	3·4
1864	130	2·0	28	·8
1865	93	2·4	34	·7
1866	45	1·7	98	1·1
1867	25	1·5	93	2·4
1868	101	1·7	45	1·7
1869	224	1·9	25	1·5
			Mean, 60	Mean, 1·7

It would appear from these figures that the maximum of sun-spot gives a maximum of ozone, and that the minimum of sun-spot gives the minimum of ozone. The years 1854 and 1863 appear to be exceptional. In 1854, however, ozone observations at Hawarden were suspended for three months, which may account for the irregularity in that year. There is, I think, in these results, sufficient to induce others to observe.

On the employment of Charts on Gnomonic Projection for the general purposes of Navigation, by G. J. Morrison.

The object of this paper is to recommend the adoption for the general purposes of navigation of charts on gnomonic projection, instead of on Mercator's projection, for the following reasons:—

1. The great circle course or shortest distance between any two points on the earth's surface is shown by a straight line on the chart. By means of a ruler, therefore, it is easy to find out in one moment the position of the great circle track along the whole course from point to point, and thus to see at a glance if there be any obstacles in the way, whereas the plotting of a great circle track on a Mercator chart involves the expenditure of a great deal of time and trouble.

2. When it is impossible to adopt the great circle course on account of obstacles in the way, it is easy, in a few moments, to lay down the best practicable course, whereas it is very difficult to do so on a Mercator chart.

3. The measurement of distances on a Mercator chart is somewhat difficult, whereas on these maps distances can be measured with a transparent scale, or a pair of compasses, in a few moments.

4. The relative position of the various points on the earth's surface is more correctly shown on these maps than on those of Mercator.

The great circle course appears to be the shortest and natural route, whereas, on an ordinary chart, it appears to be much longer than the Mercator route, and seamen get a bettter idea from these charts of the proper route to follow than they do from a Mercator's chart.

1. It may be objected that only a small portion of the earth can be got on one sheet, and there is a difficulty in drawing a great circle course between points situated on separate sheets. This is true: but by taking some pains in arranging the maps, as has been done in this case, and by repeating portions of the earth on two or more sheets, matters have been so arranged that scarcely any voyage can be named in which the ports of arrival and departure cannot be found either on the same sheet or on opposite sheets, in either of which cases the course can be laid down instantly; and even in the rare case of two ports being found on adjacent sheets only, the course can be laid down infinitely more easily than on a Mercator chart.

2. It is impossible to find the bearing of one point from another as can be done on a Mercator chart by a compass and a parallel ruler. This really is no disadvantage; no one ought to sail along a curved course, and no one need care to know anything about such a course. If this objection be seriously urged, it only proves that Mercator's charts have put false ideas into people's heads, and that other charts are required to replace them.

SECTION C—Geology

On the discovery of Microzoa in the Chalk Flints of the North of Ireland, by Joseph Wright.

The author observed that until 1872 only one rhizopod had been found in the Cretaceous rocks of Ireland, viz., *Ortitolina concava*, recorded by Mr. R. Tate, as occurring in the greensand. In November 1872, Prof. Rupert Jones read a paper before the Geological Society of Ireland, in which he announced the discovery of nine species of Foraminifera in the chalk and chalk flints of the North of Ireland.

Mr. Wright has examined the soft powdery material which often lines cavities in the chalk flints of Ireland, and has found 69 species of Foraminifera, 11 of Ostracoda, and sponge-spicules in abundance. A full list will appear as an appendix to the next Report of the Belfast Naturalists' Field Club.

Some observations on the "paramoudras" were added. The author considers that these originated in most cases by the deposit of flint around a nucleus of sponge. A microscopic examination shows that some are charged with spicules, whilst others are nearly free from them.

Prof. H. A. Nicholson exhibited and described specimens of three new species of *Cystiphyllum* from the Corniferous limestone of Canada and Ohio. Of these, *C. Ohioense*, Nich., is distinguished by its small size, deep, pointed calice, and small number of septa; *C. squamosum*, Nich., is remarkably flattened, the calice being very shallow and oblique; *C. fructicosum*, Nich., is a compound form, composed of numerous cylindrical, straight or slightly flexuous corallites.

The next paper, by the same author, was devoted to the definition of several species from the Lower Silurian of Ohio. *Alecto inflata* of Hall was regarded as an undoubted *Hippothoa*.

Description of new species of Polyzoa from the Lower and Upper Silurian rocks of North America, by Prof. H. A. Nicholson.—In this communication the author described the following new species of Polyzoa:—1. *Ptilodictya falciformis*, Nich.; 2. *P. emacerata*, Nich.; 3. *P. flagellum*, Nich.; 4. *P. ? arctipora*, Nich.; 5. *P. fenestelliformis*, Nich.; 6. *Fenestella nervata*, Nich. 7. *Ceramopora Ohioensis*, Nich.

Prof. Nicholson also read a paper on species *Favistella*. The type of the genus *F. stellata*, Hall, he regarded as identical with Goldfuss' *Columnaria alveolata*. A new species *Favistella* (*Columnaria*) *calicina*, Nich., was described.

These papers were illustrated by numerous and beautiful examples of the species referred to.

Note on the so-called "Crag" bed of Bridlington, by J. Gwyn Jeffreys, F.R.S.

In consequence of a request made by the late Prof. Phillips, not long before his lamented death, the author examined all the known collections of fossil shells from the celebrated "Crag" beds at Bridlington, and had furnished the Professor with a *catalogue raisonnée* for the new and forthcoming edition of his work on the Geology of Yorkshire. Dr. Jeffreys was lately at Bridlington with Mr. Leckenby, and ascertained that the "Crag" bed underlay the boulder-clay, and rested conformably on a bed of oolite shale of a purplish colour, which in one place appeared to have been triturated and redeposited in the form of clay. In this purplish clay they found a specimen of *Turritella erosa*, Couthouy (an arctic and North American shell), besides many other species which were common to the boulder-clay and Bridlington bed. All the species of shells found in the Bridlington bed, 64 in number, were high northern and now living. The author suggested that this deposit of shells might have been caused either by a deviation of the great arctic current in ancient times or by glacial conditions. It had clearly no relation to the Norwich Crag, as was formerly imagined to be the case.

SECTION D—Biology

Department of Anatomy and Physiology

This department was not distinguished by any communication which excited such popular interest as that of Prof. Ferrier last year, but it was fully up to the average of the last few meetings in the solidity of the papers and of the discussions. The President, Prof. Redfern, opened the Section with the address printed in full in NATURE, vol. x. p. 327, which was no less admirable in style and elocution than in matter. If this was a model of a professorial lecture, the address of Dr. Hooker, also delivered before the entire Section, was equally one of a popular exposition of new and difficult scientific observations. The excellent series of illustrations and the actual specimens of the plants described, which were sent by Dr. Moore from the houses of the beautiful Botanical Gardens in Dublin, completed the interest of this admirable address.

The only report made to the department was from the committee appointed to investigate the conditions of intestinal secretion. It contained details of about sixty experiments, which confirmed, in the case of cats, Moreau's observation of the effect of division of the mesenteric nerves, showed that the secretory nerve fibres did not pass through the splanchnics, and ascertained the local effect of various neutral salts on intestinal secretion, as well as the interference of chloral, morphia, and other drugs with the local action of magnesian sulphate. The committee* was reappointed for the present year to continue these researches on the secretion and the movements of the intestines.

The most important communication on the first day was from Prof. Cleland, *On the Development of the Brain and the Morphology of the Auditory Capsule.* Beside many characteristically ingenious suggestions, the author maintained that the fourth ventricle is roofed in by nervous matter at an early period in the embryo, of which the ligula and the choroid plexus are the permanent vestiges. He also attempted to draw a parallel between the flocculus with the portio mollis and the optic lobes, tracts, and nerves. Prof. Huxley criticised these views at some length, dwelling particularly on the comparatively late development of the optic tracts, and denying that the roof of the primitive nervous canal is ever completed in the region of the bulb. A certain Goodsirian transcendentalism which appeared in Prof. Cleland's remarks has become rare among the younger school of morphologists, and probably stimulated his critic to attack what must have seemed like the revival of a thrice-slain foe; but apart from interpretations and views, there were several important observations in the paper which, it is hoped, will be given in detail with the necessary drawings.

A paper by Mr. Thomson followed, *On the Decomposition of Eggs*, in which the purely chemical changes, the penetration of bacteria, and the growth of fungi were severally described;† and Dr. Macalister exhibited a human skull with the rare abnormality of a lacrymo-jugal suture.

After the crowded audience which listened to Dr. Hooker's address on Friday had dispersed, it seemed as if the room would have been left to anatomists and physiologists; but the arrival of blacksmiths, who began to erect a large black canvas, attracted popular interest, and the visitors who flocked in were rewarded by hearing and seeing Mr. Waterhouse Hawkins discuss the true character of the so-called clavicles of Iguanodon. His account of the difficulty he experienced in building his model with these bones in the position at first assigned them by Prof. Owen, of his finally hanging them up in front of it to be fitted in after each spectator's taste, and of the shameful destruction of the results of his skill and labour at New York, was no less graphic than the illustrations with which he proceeded to cover the canvas, showing the great reptile in every posture which would consist with the disputed bones being clavicles, ossa pubis, or marsupial bones. Mr. Hawkins advocated the last as the true character; but though in the discussion which followed, some anatomists were disposed to admit this approximation of the highest of reptiles to the marsupial (or rather to the monotreme) mammals, others refused to admit any reason for rejecting the identification of the bones in dispute with the long bird-like ossa pubis of allied reptilian forms, which was made several years ago by Prof. Huxley. So at least the professor himself must have thought, for he only appeared at the conclusion of the discussion in time to hear Mr. Balfour's remarkable paper *On the Development of Sharks*. This will doubtless appear elsewhere in full. It was crowded with facts, well observed, well stated, and well illustrated; and will prove of first-rate importance, not only for ichthyology but for the general doctrines of vertebrate development. Of many new facts ascertained, perhaps the most startling is the development of the notochord by direct cellular proliferation from the hypoblast. Whether it will ultimately be found that this is its normal mode of formation among Vertebrata, or that it may be developed from different layers in different animals, the effect of this observation will be almost equally important. Those anatomists who examined the beautiful series of sections on which Mr. Balfour founded his conclusions were satisfied of the accuracy of his histological facts. Prof. Huxley congratulated the author of the paper in terms of high commendation, though he inclined to believe that the apparent development from the lower embryonic layer might really be a secondary process. Mr. Lankester and Dr. Foster spoke of the service rendered to biology by Dr. Dohrn's Institute at Naples, where Mr. Balfour's observations were made, an institute to the success of which the British Association had the honour to contribute.

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* Dr. Brunton and Dr. Pye Smith.

† This paper will be found reported in the *London Medical Record* for Sept. 9.

The following paper by Prof. Redfern, *On Food in Plants and Animals*, has been well reported in the *British Medical Journal* for August 29, p. 285. It was illustrated by a striking series of specimens of plants growing on different soils, and the laws of nutrition in organised beings generally were applied with great force to the practical question of the food of the labouring classes in the north of Ireland. Well delivered, and clearly expressed, it appeared to be understood as well as applauded by a full audience.

The first paper read in the department on Monday was by Prof. Macalister, *On the Tongue of the Great Anteater*, including an account of its enormous retractile muscles and of the salivary glands. In a discussion which followed, reference was made to the original dissection of *Myrmecophaga* by Prof. Owen, and also to the observations of Mr. Flower on the same parts, of which a summary was published in the *Medical Times and Gazette* of last year.

The next paper, by Dean Byrne, was an attempt to connect the functional development of thought with the structural development of the brain, in their gradual evolution throughout the Vertebrata, as well as in their growth from the infant to the adult. Many interesting facts of animal psychology were related, and many acute comments offered, but unfortunately the works from which the author drew his facts of anatomy, pathology, and development were either antiquated or otherwise imperfect representations of the present state of knowledge on the points in question.

Though the paper which followed was also by an outsider, the Professor of Chemistry in Edinburgh has had the advantage of a medical training, and his anatomy and histology were as accurate as his physics. Nothing could be more interesting than the way in which Dr. Crum Brown described the methods he employed to ascertain the exact position of the semi-circular canals of the ear, and the experiments he made on the sense of rotation. The substance of the communication will be found in the last number of the *Journal of Anatomy and Physiology*. Notwithstanding some criticisms offered by Mr. Charles Brooke on the acoustics of the paper, both its anatomical facts and its conclusion as to the function of the canals appeared to find general acquiescence; and this research may be regarded as another proof of how rich a field lies on the border-ground between the artificial territories into which we have divided the world of science.

Before the department rose, Dr. Caton exhibited a new adaptation of a microscope on the Hartnack model, for the purpose of examining the tissues in living mammals. It was a cheaper, and, as the author believed, a more readily applicable modification of the apparatus exhibited by Professors Stricker and Sanderson, at the Edinburgh meeting of the Association.

Prof. Huxley opened the last day of session with an account of his recent observations on the development of the *Columella auris* in Amphibia. While fully confirming the position of the quadratum (or malleus) in the mandibular arch of vertebrates, and of the incus in the hyoidean, these investigations appear to show conclusively that in the amphibian, at least, the columella (or stapes) begins as an outgrowth from the periotic capsule, and is therefore unconnected with any visceral arch; although, as the speaker was careful to state, it might yet be possible that the hyoid arch had, at a very early period, left some of the tissue of its topmost extremity adherent to the ear-capsule, and that this might afterwards give rise to the stapes. In the absence of Mr. Parker there was no one competent to criticise the paper from personal knowledge; but a word dropped as to the many changes in the accepted homologies of the ossicula auditus, elicited a masterly and characteristic exposition of the series of new facts, and the modifications of theory they have led to, from Reichert's first observations down to the present time. The embryonic structures grew and shaped themselves on the board, and shifted their relations in accordance with the views of successive observers, until a graphic epitome of the progress of knowledge on the subject was completed.

Mr Lankester's paper which followed was also embryological. He described his observations on the development of the eye of Cephalopoda, made like those of Mr. Balfour in the Dohrn Institute at Naples. After correcting several of the statements made in text-books on the authority of Prof. Kölliker, the author pointed out the relation of the eye in the Dibranchiata to the less specialised organ of Nautilus, and showed how the ontogenesis of this structure in the highest mollusk corresponds with its gradually increasing complexity from its first appearance in the group, thus meeting one of Mr. Mivart's objections.

The session was appropriately concluded by a paper from the President, describing experiments made several years ago on the effects of ozone. The animals used were rabbits, and Prof. Redfern found them much less injuriously affected by breathing highly oxygenated air than has been supposed, while ozone in moderate amount (·4 per cent. and upwards) proved rapidly fatal, producing spasms, and death by apnœa. The lungs were found extensively emphysematous and congested, with engorgement of the right side of the heart.

Thus ended a busy and not uneventful meeting of the department. Comparing it with recent years, the room was never so crowded as it sometimes was at Bradford, nor so empty as it usually was at Brighton and Edinburgh. The most important paper last year, that of Prof. Burdon-Sanderson on the electrical changes which accompany the contraction of Dionæa, excited little popular interest, and the discussions at Edinburgh on various points of Cetacean anatomy, though carried on by Turner, Flower, Macalister, Struthers, and Murie, were caviare to the general. This year a corresponding importance may be fairly assigned to the embryological papers contributed by Prof. Huxley, Mr. Ray Lankester, Mr. Balfour, and Prof. Cleland. With a fair proportion of more popular expositions, the solid contributions which have been made during the last five or six years should attract a more constant attendance of anatomists and physiologists to this department. There were several distinguished Irish members of the Association whose presence was greatly missed at Belfast; and considering its nearness to Scotland, there was a remarkable lack of representatives from the northern universities. Apart from the intrinsic value of the papers read, there is so much to be gained from personal contact and discussion with men working at the same objects, that few probably feel at the conclusion of a meeting that they have not been rewarded for the sacrifice of time and convenience, and the scientific value of the Association entirely depends on its power of attracting those who are seriously engaged in the prosecution or communication of the subjects which form its several branches.

SCIENTIFIC SERIALS

Geological Magazine, September.—This number contains four original articles :—(1) The grouping of the Permian and Triassic rocks, by H. B. Woodward, F.G.S. The object is to show that the supposed break between the subdivisions of the Triassic rocks in England rests on unsatisfactory evidence; that in the Permian beds there are evidences of unconformity; and that probably future researches will lead to the resumption of the term "Poikilitic" to embrace both the Permian and Trias.—(2) On the Pleistocene deposits yielding Mammalian remains in the vicinity of Ilford, Essex, by Messrs. Woodward and Davis. This article consists partly of references to previous numbers of the magazine, the chief feature of interest in it being a letter by Mr. Searles Wood. He formerly believed the Ilford brick earths were older than the main sheet of the Thames gravel; a view which he now corrects.—(3) On the remains of *Rhinoceros leptorhinus*, Owen, from the Pleistocene of Ilford, by the editor. This is a reprint of Mr. Davis's description of the skull, as given in Sir Antonio Brady's catalogue (privately printed), together with an extract from Dr. Falconer's palæontological memoirs.—(4) On West Indian Tertiary Fossils, by R. J. Lechmere Guppy; a first instalment of descriptions which are to be continued.—Mr. J. W. Barkas, in a letter, announces that he has found a jaw of *Amphicentrum*, in sub-carboniferous limestone near Richmond, and suggests that it must have lived both in fresh and salt waters, like some modern fishes.

Astronomische Nachrichten, No. 2,005.—L. Seidel contributes a paper on the estimation of the most probable value of a number of varying observations of the same phenomenon, as the value of a number of observations of the position of a double star. There are also a quantity of position observations on Coggia's comet, by C. H. Davis, Ant. Aguilar, and Alexander Gromadzki, and the following elements of this comet are found by W. Fabritius:—

$$\begin{aligned} T &= \text{July } 8{\cdot}90006 \\ \text{Log. } q &= 9{\cdot}829699 \\ \Omega &= 118^\circ\ 44'\ 9''{\cdot}6 \\ i &= 66^\circ\ 23'\ 1''{\cdot}0 \\ \omega &= 152^\circ\ 21'\ 42''{\cdot}4 \end{aligned}$$

The opposition ephemeris of the planet Hecate (100) is contributed by Dr. J. E. Stark for each day from Sept. 17 to Oct. 27.—Prof. Spoerer sends a table of his observations on solar spots and protuberances for June. Capt. Herschel writes to ask for letters of Sir J. Herschel, stating that a collection is being made.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, Sept. 7.—M. Frémy in the chair.—M. Resal presented the Academy with the second volume of his "Traité de Mécanique Générale," and made some remarks thereon.—M. P. Volpicelli addressed a letter to the president, stating that in 1854 Melloni had communicated a note to the Academy, entitled "Researches on Electrostatic Induction." Fifteen days afterwards the Italian physicist died of cholera at Naples, and since that time the author (M. Volpicelli) had submitted fifteen communications to the Academy on the same subject, all of which confirmed Melloni's theory of electrostatic induction. M. Volpicelli now begs the Academy to appoint a commission to report on these experiments, and expresses a hope of being permitted to repeat them before it. MM. Becquerel, Faye, Frémy, Edm. Becquerel, and Jamin were named commissioners.—Sixth note on the electric conductivity of ligneous bodies, by M. Th. du Moncel.—Presence of zircosyenite in the Canary Isles, by M. Stan. Meunier. The mineral was found in a collection made by M. Webb on the Pena Mountains.—On some laboratory experiments concerning the action of toxic gases on *Phylloxera*; actual state of the malady in the Charente provinces; extract from a letter from M. Maurice Girard to M. Dumas. The gas tried was that liberated from a sulphocarbonate. Pieces of brick saturated with the solution of the salt were placed in the bottoms of flasks; above the solution and saturated brick some strong paper was supported on which were placed phylloxerised roots. The roots thus escaped direct contact with the solution and received only the gases evolved (CS_2 and H_2S). At the end of twenty-four hours nearly all the insects were dead, with the exception of some small larvæ and some eggs; at the end of two days all the insects and the greater part of the eggs were dead; while at the end of four days complete death of the eggs took place. During the experiment the flasks were kept in the dark, and some control flasks containing phylloxerised roots only placed with the others: nearly all the insects and eggs survived in these last flasks.—On some new points in the natural history of *Phylloxera vastatrix*; a letter from M. Lichtenstein to M. Dumas. The author thus sums up the life history of the insect so far as at present known:—(1) Colonising females appearing probably in August and September; (2) small uniform progeny hybernating; (3) Oval, pyriform, testudiniform types, reproducing by parthenogenesis all the summer; (4) Pupæ of two forms, oval and narrow at the waist, specially found on the nodosities of the rootlets in June and July; (5) *Swarming* takes place in August: the insects emerge from the earth in myriads exactly as in a formicary when the winged insects escape; (6) Laying of eggs on the leaves of *Quercus coccifera*, end of August; (7) Birth of sexual apterous individuals. Copulation and production of colonising females.—On some processses for destroying *Oidium* and *Phylloxera*; extract from a letter from M. Desforges to M. Dumas.—Employment of the lime from gas purifiers to check *Phylloxera*; extract from a letter from M. L. Petit to M. Dumas.—Observation of an extraordinary passage of corpuscles across the sun; a telegram from M. Gruey, of the Toulouse Observatory, to the president. The passage took place on the 5th, 6th, and 7th of the present month.—On some applications of Abel's theorem relating to elliptic functions to curves of the second degree, by M. H. Léauté.—Note on magnetism, by M. F. M. Gaugain; a continuation of former researches.—Note on the nature of the sulphurising compound mineralising the thermal waters of the Pyrenees, by M. E. Filhol.—Note on chlorophyll, by M. E. Filhol. The chlorophyll of monocotyledons (Graminæ, Cyperaceæ, Liliaceæ, &c.) treated with a small quantity of hydrochloric acid becomes turbid, and the solution, on filtration, leaves a black crystalline compound on the filter. This substance has been examined in some detail. It is remarkable that a solution of chlorophyll from dicotyledons yields, under the same treatment, a dark compound which is amorphous.—On some phenomena of localisation of mineral and organic substances in Mollusca, Gasteropoda, and Cephalopoda, by M. E. Heckel. Specimens of *Helix aspersa* and *Zonites algirus* were fed with white lead, or with acetate of lead mixed with wheat flour. An accumulation of metal was found in the liver and also in the cerebral ganglia *Loligo vulgaris*, *Sepia officinalis*, and *Octopus vulgaris* were fed during two months with garancine (mixed with meat). In no case was the internal shell coloured, but the cephalic cartilage and all the cartilaginous portions of the skeleton of these Mollusca were coloured after an experiment of three months' duration. The author points out the necessity of distinguishing clearly the hard parts belonging to the skeleton from those belonging to the shell.—On the storm of the night of 1st to the 2nd of Sept. 1874, observed at Versailles; a note by M. Ad. Berigny. 17 59 mm.[of rain fell during the storm, and the lightning struck four points in Versailles.

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ERRATUM.—P. 379, col. 2, line 8 from bottom, for *or* read *on*.

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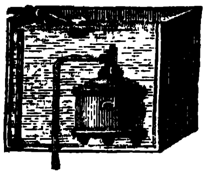

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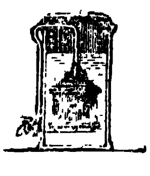

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THURSDAY, SEPTEMBER 24, 1874

THE MIGRATION OF BIRDS

THE "silly season" has this year been marked by some discussion in the newspapers on the migration of birds. The various letters published have shown the normal want, if not of knowledge, yet of profundity; and I fear lest the subject, which really deserves the best attention from naturalists, should suffer in repute by the absurdities lavished upon it.

The discussion began, if I am not mistaken, with a theory of migration set forth by a Scandinavian poet, which treated that wonderful movement as an attempt on the part of birds to attain "more light." It proceeded on the hypothesis that the birds which are summer-visitors to northern climes, finding that the days grow shorter as summer advances, retire southwards to find "more light," and that the same desire prompts their return northwards in spring. To show the fallacy of this hypothesis it is sufficient to observe that the southward movement not only begins, but is with many species in great part accomplished, long before the autumnal equinox, when consequently the birds are journeying to increasingly shorter days; and in like manner their northward movement is set on foot before the vernal equinox, with of course the same result. Whether this theory was ever intended in earnest or was only a poetic fancy I do not know, nor is it really worth while to inquire. It is enough that it contains its own refutation.

I have no intention of commenting upon the whole discussion. Few, if any, of the letters which followed contain anything to the purpose either way. But one published in the *Times* of Friday, Sept. 18, seems to require special notice, since it professes to give "the latest accepted theory" on the subject; and the writer, without actually saying that it is received by a very great authority, whom he names, intimates that it does not meet with his disapproval. Of this "latest accepted theory" I must confess I never before heard; and now that it is before me, it seems to be not only unsupported by facts, but to amount to no explanation at all. After briefly touching upon the difficulty which the shorter-winged Birds of Passage must have in effecting their voyages, the writer says:—

> "I believe it was only some twenty or thirty years ago that anything like a practical solution of the difficulty was arrived at. The birds congregating about the south coast are seized with a sudden impulse or mania to fly upwards. This is caused by some atmospheric change coinciding with a warm south wind moving in a high stratum, into which the birds soar with an involuntary motion of their wings. This motion (involuntary like that of the heart) is continued for many hours, and the birds fly blindly along until the paroxysm passes off, when they at once begin to descend, making many a fatal drop into the sea.
>
> "The same phenomenon occurs in Africa and southern countries, where the migratory birds congregate for a northern flight about April. Experiments were tried here and in Africa which tended to corroborate the above facts. Migratory birds were kept in cages along the coast, and it was found that each was seized with a prolonged paroxysm coinciding with the time that the wild birds disappeared. Cages were constructed with silk at top and bottom to prevent the birds from killing themselves; and it was noticed that after the paroxysm had passed away, the birds began to look about them, to plume themselves, and eat and drink, apparently with a notion that they had arrived at their new home."

On reading these wonderful paragraphs, some questions naturally arise. How does the writer account for his "birds congregating about the south coast?" What brings them there, that they may be "seized with a sudden impulse or mania to fly upwards?" Who has ever observed the "atmospheric change" and coincident "warm south wind moving in a high stratum?" Do these remarkable meteorological phenomena occur but once in the whole season of migration, or is there a succession of them to suit the convenience of each migratory species? Who, moreover, has seen the birds soar into this peculiar current of air? and who of such fortunate persons knows that the motion of their wings under such conditions is "involuntary like that of the heart?" Finally, what is the cause of the "paroxysm"? for, without knowing that, to attempt to explain the observed facts of migration is an attempt to explain *obscurum per obscurius*.

When a satisfactory answer is given to these questions, it will be time to inquire whether this "latest accepted theory" of migration sets the matter in any clearer light, or whether it is not as arrant nonsense as was ever foisted upon an innocent public, even at the height of the "silly season." The last paragraph of the writer's letter, I may remark, has nothing in it of consequence. Granting that the migratory impulse is instinctive, it is, like other instinctive practices, followed as far as circumstances will allow.

Permit me now to point out to those interested in the solution of this mystery of mysteries the chief matters to which the attention of observers and theorisers should be directed.

I. *The original Cause or Causes of Migration.*—In some cases scarcity of food would seem to be a sufficient cause, and it is undoubtedly the most obvious one that presents itself to our mind. As food grows scarce towards the end of summer in the most northern limits of the range of a species, the individuals affected thereby seek it in other countries. Thus doing, they press upon the haunt of other individuals; these in like manner upon that of yet others, and so on, until the movement which began in the far north is communicated to the individuals occupying the extreme southern range of the species at that season; though, but for such an invasion, these last might be content to stay some time longer in the enjoyment of their existing quarters. When we consider, however, the return movement, at the end of winter, it is doubtful, I think, whether scarcity of food can be assigned as its sole or sufficient cause. But here we feel the want of knowledge. At present we are far too little acquainted with the physical peculiarities of those more equatorial regions, which in winter are crowded with emigrants from the north, to come to any final decision. It seems not too violent an assumption to suppose that though such regions are well fitted for the winter resort of the bird-population of the north, they may be deficient in certain necessaries for the nursery; and it seems still less of an assumption to suppose that even if such necessaries are not wanting, yet that the regions in question would not supply food sufficient for both parents and offspring—the latter being, at the lowest computation, twice as numerous as the former—unless the numbers of both were diminished by the casualties of travel. But another point must not be overlooked. The most sedentary of birds year after year occupy the same quarters in the breeding season. In some instances this may be ascribed, it is true, to the old haunt affording the sole or the most convenient site for the nest in the neighbourhood, but in so many instances such is not the case, that we are led to believe in the existence of a real partiality, while there are quite enough exceptions to show that a choice is exercised. The same may equally be said of the most migrant of birds, and perhaps the strongest instance that has ever come to my knowledge refers to one of the latter. A pair of Stone Curlews (*Œdicnemus crepitans*)—a very migratory species, affecting almost exclusively the most open country—were in the habit of resorting for many years to the same spot, though its character was entirely changed. It had been part of an extensive rabbit warren, and was become the centre of a large and flourishing plantation. It seems to me, therefore, that among the causes of migration the desire of returning to old haunts must be included.

II. *The Mode or Modes of Migration.*—This heading is capable of much subdivision. The means of transition are of course found in the bird's wings, but do all birds migrate in the same manner? Nay, more, does the same species of bird migrate in the same manner at all times? And how is its return to the old haunt accomplished with a degree of certainty that in most cases may be called unerring?

That all birds do not migrate in the same manner is pretty plain. Some, as the swallows, conspicuously congregate in vast flocks, and so leave our shores in a large company, while the majority of our summer visitors slip away almost unobserved, each apparently without concert with others.

It is also pretty nearly certain that the same species of bird does not migrate in the same manner at all times. Mr. St. John tells us of the arrival of skylarks on the coast of Norway:—"They come flitting over in a constant straggling stream, not in compact flocks." Yet it is notorious that a little later these same birds collect in enormous flocks, which prosecute their voyage in company. As tending to the same conclusion, I need hardly do more than refer to the excellent observations of Mr. Knox on the movements of the Pied Wagtail ("Ornithological Rambles," third edition, pp. 81—86) and, indeed, to the whole of his remarks on migration, because they must or ought to be known to everyone who takes an interest in the subject. But more than this, it is pretty nearly certain that of the majority of northward migrants in spring the males take the lead, and anticipate the advent of their mates by some days, not to say weeks—a fact which may possibly indicate the existence of another cause of migration to which I have not before alluded—while this peculiarity has never been observed in the autumnal movement.

Then comes the question, How is it that birds find their way back to their old home? This seems to me the most inexplicable part of the whole matter. I cannot even offer an approach to its solution. There was a time when I had hopes that what is called the "homing" faculty in pigeons might furnish a clue, but my good friend Mr. Tegetmeier has cruelly deprived me of that consolation, declaring that knowledge of landmarks obtained by sight, and sight only, is the sense which directs these birds, with which he is so conversant; while sight alone can hardly be regarded as much of an aid to birds—and there is some reason to think that there are several such—which at one stretch transport themselves across the breadth of Europe. Here I have no theory to advance, no prejudice to sustain. I should be thankful indeed for any hypothesis that would be in accordance with observed facts. They leave no room for chance and not much for counteracting forces. Occasionally the return of the nightingale, the swallow, or other land birds, may be somewhat delayed, but most sea-fowl can be trusted as the almanack itself. Were they satellites revolving around this earth, their arrival could not be more surely calculated by an astronomer. Foul weather or fair, heat or cold, the puffins repair to some of their stations as regularly on a given day as if their movements were timed by clock-work. Whether they have come from far or from near we know not, but other birds certainly come from a great distance, and yet they make their appearance with scarcely less exactness. Nor is the regularity with which certain species disappear much inferior; every observer knows how abundant the swift is up to the time of its leaving its summer home, and how rarely it is seen after that time is past. Yet all this, marvellous as it may seem, is far less marvellous than the instinct, or whatever else we may call it, which guides the birds in their voyages, and gives them the power of directing their flight year after year to the same spot. The solution is probably simple in the extreme—possibly before our eyes at this moment if we could but see it—but whosoever discovers it will assuredly deserve to have his name remembered among those of the greatest discoverers of this or any age.

ALFRED NEWTON

COMPETITIVE EXAMINATIONS

IN so universally substituting Competitive Examination for the much less perfect systems of patronage and favouritism previously adopted for filling appointments and distributing emoluments, no doubt the step has been in the right direction; but as with all novel systems, the necessary details of its working have not been fully mastered, and we have complaints,—such as from many who have no other recommendations upon which to make selections in scientific appointment, and from the India Civil Service,—that the results are not, in the long run, so successful as could be wished. Many of the objections which were at the outset thought to be insurmountable, have been proved to be insignificant and remediable; whilst others, unforeseen and more difficult to overcome, are daily becoming more and more conspicuous.

The most important of these objections depends on the fact that it is impossible, from the list of successful candidates, even when they are classed according to the number of marks they have obtained, to determine whether they belong to the one or the other of two very different qualities of mind. There are certain students whose chief capacity consists of a very excellent memory in combination with a power of discriminating what is, and what is not, important in an examination point of view. These, in the hands of an experienced teacher, an able "crammer," or with well-selected books at their disposal, are able, by dint of hard work, so far to make up for their own deficiency in originating power, as to appear, in an examination conducted on ordinary methods, indistinguishable from those who, by accurate observation and much less reading than themselves, have from their superior capacity been able to obtain the same amount of information. What is the result? Taking an instance in which one of each of these classes competes, one against the other, perhaps the former has come out senior and the latter second in the examination list. The latter knows that he might have done better without much effort, and is in no way injured by being beaten. But the former is in a very different position. He finds himself placed above a man of acknowledged great ability, and from this in his smaller mind he infers that he is greater still, considering that he has beaten all. He goes forth into the world with a conscious and unfounded feeling of power; sets up for being a genius; and though his capacities may be anything but inconsiderable, he completely over-estimates himself. If he is a man who has to get his living entirely by his own work he most probably attempts the highest things; to become a barrister or a physician rather than to follow the routine of a solicitor or a general practitioner, for which in reality he is more suited. When the struggle for life commences in earnest he has the continual mortification of seeing others, to whom he has been led by his examination results to think himself superior, passing him on account of their greater ability. This sours his disposition, depresses him unwarrantably, compels him ultimately to relinquish his higher aspirations, and, as a despondent cynic, makes him take to the more humble line of action which at the time of his success he despised so thoroughly.

This is not an overdrawn picture, its counterpart may be seen on all sides, and many more like it will be forthcoming if some radical change is not made in the method of examination now in vogue. What that change must be deserves the serious consideration of all interested in the progress of every branch of social economy, as well as of those who have the responsibility of filling posts of scientific importance. In this respect we think that the older Universities, Oxford and Cambridge, in their more venerable honour examinations, set by far the best example. How accurately, in many of the colleges, the exact mental capacities of those of its undergraduates who are candidates for honours are known, is also more than surprising to the uninitiated. The reason of this is that the examiners are men of acknowledged ability, and what is as much to the point, they have themselves gone through the same training, with the same objects in view, as those whom they are comparing. The ultimate object of work has no doubt a very important bearing on the manner in which it is undertaken; and it is hardly to be wondered at that in a competition like that for the India Civil Service, in which so painfully large a number of subjects is frequently included by some of the candidates, specialist examiners find it extremely difficult to judge, from the undigested mass of answers they have to compare, which is the least bad of the candidates before them. In institutions like the University of London, the system of offering scholarships to be competed for in special "honours" examinations, which follow those for simply obtaining the degree, has, in many cases we could refer to, had the same injurious effect of giving men a false estimate of their own practical power of getting on in life; and whether in the long run the older method of conferring degrees after a pass examination only, without any associated pecuniary reward, is not the best is still a subject quite *sub judice*. In Medical Science this is particularly the case, for in it, more than or as much as in any other, a purely theoretical knowledge of any department of Chemistry, Physics, or Biology, is but of slight value in comparison with the experience of the bed-side, when the commencing practitioner is called upon to diagnose and prescribe without any assistance from others.

In the Universities of Oxford and of Cambridge we have an opportunity of watching the working of the two different systems of examining competing candidates. In the former the lists appear with the names in each arranged alphabetically in three or four classes, and not according to the actual merit in each class. The public are therefore told by this method the average standard to which a man has risen, and no more; for the rest they are left to judge by other entirely independent and perfectly voluntary performances by which he has the opportunity of exhibiting the quality of his ability. In Cambridge the tripos lists place each man in exactly his place with regard to the other men of his year who have taken up the same subject as himself, and every attempt is made to maintain all the triposes at such a standard that corresponding classes indicate similar ability. From the remarks with which we commenced it is evident that the Oxford system has many advantages; and that the other is liable to lead to the injurious result we have mentioned, which in that particular case it does not, on account of the antiquity of the system and the extremely careful way in which the examinations are conducted.

It is the fashion in most modern examinations to include a large number of subjects, many of which may be taken up by each candidate. This, no doubt, is a mistake in many instances. It is not so much information that is wanted in a young man—that will come when the stimulus for showing it becomes greater, but the exhibition of mental capacity; and with examiners of any worth, who have had any experience, it is not at all difficult to estimate the powers of candidates from a very few answers in a very few subjects, especially if any *vivâ voce* and practical questions are included.

A competitive examination should therefore have for its object the estimation of the power of the candidate, and that only. It should be so conducted as to place him on a standard table in such a position that if it were possible from a physical examination of his brain to judge of his brain capacity, the results of the two methods would coincide. This can be best attained by restricting the examination to a few subjects; by asking questions which call for method in their answers rather than fact; and by having able examiners who are acquainted with future work to be expected of the candidate. Candidates thus selected in the long run must certainly be found more satisfactory than those chosen by any other method.

METEOROLOGY IN MAURITIUS

Results of Meteorological Observations taken in 1872 *at Mauritius; Monthly Notices of the Meteorological Society of Mauritius*, 1873; pp. 23 to 53.

THE work of meteorological observation and discussion at this important station continues, as shown by these papers, to be prosecuted under Mr. Meldrum's direction with marked energy and success. The observations at the observatory, which are made five times daily, embrace atmospheric pressure, temperature, humidity, cloud, rainfall, wind, thunder, lightning, and meteors, of which the "Results" present us with a full and carefully prepared summary. We observe with much satisfaction that a barograph is in operation at this important observatory, and very earnestly hope that future annual publications will give meteorologists what is greatly desiderated, viz., the data for the determination of the hourly barometric fluctuations of that region. It is stated that the monthly means of the dry and wet bulb thermometers have been derived from the observations at 6 and 9½ A.M. and 3½ and 9½ P.M.; but those of the barometer from the observations at 9½ A.M., 3½ P.M., and 9½ P.M. The formula employed in each case should in future be explicitly stated. We infer from an examination of the table that the barometric means are derived from the formula $\frac{9\frac{1}{2} + 2 \times 3\frac{1}{2} + 9\frac{1}{2}}{4}$; but as regards the thermometers, we have no means of knowing how the observations at the four hours were combined in deducing the mean temperature, since the means of temperature at these hours are not printed. Considering the hours at which the observations are made, the best formula for the mean temperature would be $\frac{9\frac{1}{2} + 3\frac{1}{2} + 9\frac{1}{2} + \text{min.}}{4}$. But the most satisfactory course would be to give the averages at the observed hours, leaving it to each to deduce from these the approximate mean temperatures. In all published annual results the simple averages of actual observations ought to be given, and these should in no case be made to give way to averages hypothetically deduced.

The rainfall has long occupied the attention of the Mauritius meteorologists, and a table is given showing the results of the rainfall at thirty-five stations. The annual amounts vary greatly, from an annual average of 33 in. at Gros Cailloux to 146 in. at Cluny. The important bearing of the rainfall on the products and health of the island has been ably pointed out by Mr. Meldrum. It is much to be desired that this very energetic society should establish stations at suitable points over the island, at which observations of pressure, temperature, wind, &c., would be made. The position of the island, its peculiar physical configuration, and variety of vegetable covering, afford remarkable facilities for the investigation of not a few meteorological problems, such as the influence of forests on climate, and the daily march and phases of the pressure, temperature, and humidity of the air as influenced by height, exposure, and the character of the vegetation in the immediate neighbourhood of the instrument.

The paper drawn up by Mr. Meldrum for the Vienna Meteorological Congress regarding the practicability and utility of storm warnings is of considerable value, the subject having long received full and able investigation at Mr. Meldrum's hands, and the correctness of his deductions been abundantly tested by the success attending the warnings issued by him. The chief, and indeed only difficulty, in the way of the complete success of the system of warnings at Mauritius is the uncertainty as to when and where an advancing cyclone may recurve.

But the most valuable article in these papers is the one by Mr. Meldrum "On a rainfall periodicity corresponding with the sunspot periodicity." The article is a fine instance of a broad and comprehensive discussion of the question dealt with through its details, and of an extreme caution in constant exercise in drawing the conclusions. The result arrived at is this:—Whether we take the annual rainfall over the largest possible portion of the globe for short periods, or over a smaller portion for a longer period, we arrive at the same result, viz., an increase of rain at or near the epochs of maximum sunspot area, and a decrease of rain at or near the epochs of minimum sun-spot area. The exceptions are few and trifling, being only such as might be expected in this as in other questions of physical research, and they all gradually and inevitably disappear from the results as the inquiry is made to cover more extended portions of the earth's surface and a longer interval of time.

Much interest attaches to the prosecution of the inquiry regarding the relations of solar and atmospheric changes into other branches of meteorology, such as the pressure, temperature, humidity, electricity, and motions of the air. Does the temperature fluctuate with the sun-spot period? and if so, is the increase and decrease uniform and simultaneous over the globe, or do the warm and cold periods differ widely in different regions? How is the distribution of atmospheric pressure affected? Are the inequalities intensified or reduced, or does the difference find expression chiefly in a greater or less disturbance of the atmosphere, resulting in an increase or decrease of the daily fluctuation as measured by the observed differences in the readings made, say at 9 A.M. from day to day? In the further development of "the meteorology of the future," these are some of the more important questions that will be first inquired into.

OUR BOOK SHELF

A Manual of Metallurgy. By W. H. Greenwood, F.C.S., Associate of the Royal School of Mines. (London and Glasgow: W. Collins, Sons, and Co., 1874.)

THE author states that the work is "primarily designed" for the use of students preparing for the advanced stage of the examinations of the Science and Art Department! This, the first volume, contains 250 pages, of which 150 are devoted to iron and steel. And it may be observed that as there is an excellent treatise on the Metallurgy of Iron, by Bauermann, in Weale's Series, this part is less needed by students than the second, in which the metallurgy of copper, lead, zinc, silver, gold, mercury, nickel, cobalt and aluminium, will be described.

Mr. Greenwood has availed himself of his notes of Dr. Percy's lectures at the Royal School of Mines, and has spared no pains in gathering materials for the work from original memoirs, as well as from the few well-known French and German metallurgical works. The chapters on fuel and fire-clays are necessarily brief; but those relating to iron are satisfactory. The author has described the recent improvements made with a view to supersede manual labour in puddling—such as the rotative furnaces of Siemens and Danks. Siemens' process for the production of wrought iron direct from the ore is also given, and the excellent researches of Bell, Snelus, and Dr. W. M. Watts are duly noticed. In the rest of the book, the metallurgy of tin, antimony, arsenic, bismuth, and platinum are somewhat briefly treated. The various processes are illustrated by fifty-nine well-chosen engravings.

The book contains some curious verbal errors; but, viewed as a whole, we have no hesitation in saying that the work is good, and may be recommended to the class of readers for whom it is intended.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Fossils in Trap

THE occurrence of fossils in the volcanic rocks of our Scottish carboniferous series is by no means uncommon. A conspicuous example was described by me in the "Transactions of the Geological Society of Glasgow," vol. ii. p. 97.

The plant remains thence derived were afterwards figured and described by Mr. Binnie of Manchester, and Mr. Carruthers of the British Museum, and in the latter institution are deposited large polished slabs of entire trees, together with specimens of the enclosing rock.

At a later period a tooth of *Ctenodus cristatus* was also discovered in the same beds. The analysis of the rock was made by the late Mr. John Wallace Young, and given by him in the *Chemical News*, vol. xiii. p. 73.

The rock enclosing these remains is so heavy and compact, so completely devoid of any signs of stratification when fractured, that all previous investigators, from Prof. Buckland in 1819, down to Dr. Bryce in 1865, dismissed it with a conclusive click of the hammer as simply *trap rock* not likely to contain fossils.

The condition in which the fossils are found may be described in the precise words of your Nova Scotia correspondent (NATURE, vol. x. p. 398), as "*indissolubly united with trap;*" nevertheless, there is every probability that originally the enveloping matrix must have reached the fossils in the shape of volcanic ash, or, more likely still, in the shape of a thick fluid sediment enveloping the trunks of the trees as they stood erect, with their broken branches, leaves, and fruit scattered around them. We have numerous instances of ash-beds overlying limestone beds containing corals, and I suspect Mr. Honeyman's "*trap rock in a fluid state*" would resolve itself into a rock of the nature above indicated; at all events, it would be very interesting to geologists on this side to receive specimens for closer examination. With regard to the possibility of fossils being enclosed and preserved in fluid lava, I may mention that when at Catania in 1867, I was informed by Prof. Sylvestri that oak trees on Mount Etna when overtaken by lava streams are not actually annihilated, but the lava forms a sort of hollow cylinder around the trees, in which they are carbonised, and the silex contained in the wood collects in a fused mass at the bottom of the trunk. Such fused masses I met with at the foot of some of the stems of trees excavated by me at Arran, and numerous pebbles, evidently derived from the same source, are to be picked up on the shore between the Fallen Rocks and the Scriden at the north end of Arran. E. A. WÜNSCH

Loch Ranza, Arran, Sept. 19

Chrysomela Banksii

IN answer to Mr. Moggridge (NATURE, vol. x. p. 355), his conjecture as to *Chrysomela Banksii* is correct; though whether the fluid it emits is irritating or not I cannot say. It is a habit possessed by the allied generæ Linæ and Timarchæ.

Camberwell Road, Sept. 16 H. POWER

Meteor

THE following is an account of a brilliant meteor which appeared at 8.53 P.M. on Wednesday, Sept. 16:—

Size: about four times that of Jupiter.
Colour: blue, with a red tail.
Brightness: throwing a shadow deeper than that of a full moon.
Angular measurement of tail: from 12° to 15°.
Duration: about 15″.
Direction of course: N.W.
Zenith distance of point of disappearance: 75°.

The brilliancy of the tail threw a red light on the surrounding landscape. G. H. HOPKINS

Bisterne Close, Burley, Hants, Sept. 16

THE INTERNATIONAL CONGRESS OF ORIENTALISTS

THE second meeting of students of Oriental Literature and Science has been brought to a successful termination under the presidency of Dr. Samuel Birch, Keeper of the Oriental Antiquities in the British Museum. On Monday, the 14th inst., the Congress was opened at the Royal Institution, 21, Albemarle Street, when the president delivered a brilliant and highly interesting address upon the scope and value of these annual meetings.

"Our century," said Dr. Birch, "has seen a striking revival of Orientalism, and the discoveries in Mesopotamia, Egypt, India, and Persia have brought again into light, ancient and almost forgotten monarchies, religions, and tongues, as they existed 4,000 years ago. Modern travellers have left no accessible monument uncopied, and immense material is now at the student's disposal—for the first time, a contemporary history of recorded events in these old times. In Egypt only the other day, M. Mariette discovered fresh inscriptions at Karnak recording the conquest of Thothmes III. These enabled him, in a paper just read before the French Academy of Inscriptions, to propose important reforms in our Egyptian geography. Mr. George Smith's excavations at Kouyunjik have brought to light new Assyrian texts; whilst in India, General Cunningham's labours promise very important results. Every facility should be given for excavations in the East, especially for such as follow up the hints afforded by monumental information. Two monumental discoveries made in recent times are of supreme importance, namely the Canopus triglyph tablet and a bilingual inscription of Dali, 'Idalium,' in Cyprus. The Canopus stele has proved beyond a doubt, if doubt still lingered in dark corners, the truth of the decipherment of the hieroglyphs, whilst the Dali text has led to the recovery of the old Cyprian language, which turns out to be of Greek form. The Mesopotamian and Egyptian monumental discoveries make us acquainted with old submerged empires, and the Moabite stone is the most ancient document of alphabetic writing."

On Tuesday the second day's work commenced with the president's reception in the Egyptian and Oriental Department of the British Museum. The meeting of the Semitic Section, under the presidency of Sir Henry Rawlinson, took place in the theatre of the Royal Institution, where the learned Assyriologist delivered his opening address, in which he spoke on the great importance of the Semitic group of languages.

On the conclusion of this address Prof. Jules Oppert, in a lengthy speech delivered in French, brought before the meeting the result of his labours upon the second of the three inscriptions of King Darius at Behistun.

On Wednesday, after an entertainment by the Right Hon. Sir Bartle Frere, and a reception at Kew Gardens by Dr. Hooker, in his capacity as President of the Royal Society, the Turanian Section opened its session at King's College, under the presidency of Sir Walter Elliot. After his address a very interesting paper was read "On the Study of Turanian Languages," by Prof. Hunfalvy, of Hungary. In this paper the Professor showed by numerous facts adduced from Hungarian, Wogul Ostiak, and Finnish, that the established notion of Turanianism seems not to be well founded, and that by the accepted maxims it leads the student into many errors. The author endeavoured to show, consequently, that the same method of studying, which has created the Aryan and Semitic linguistic science, must also be applied to the Turanian languages, and that before such a perfect scientific method is reached, every comparative study of them must be unavailing.

Perhaps the most interesting paper was entitled "The State of the Chinese Language at the time of the invention of Writing," by Rev. J. Edkins, in which the author treated of the state of opinion as to the time of the invention of Chinese writing, the changes in the language during the last 1,200 years, and from the time of Confucius till A.D. 600; and laid down the theory that the Chinese characters are an index to the sound of the words at the time of the invention, and that from them may be learned the phonetic changes that have since taken place; they are also an index to the nature and extent of the vocabulary then in use, and a measure of the civilisation that had then been attained.

On Tuesday, the 17th, the Aryan Section sat at the Royal Institution under the presidency of Prof. Müller, whose address was listened to with absorbing interest; we have only space for a few extracts.

What is the real use of an International Congress of Orientalists? asked the president. During the last hundred, and still more during the last fifty years, Oriental studies have contributed more than any other branch of scientific research to change, to purify, to clear, to intensify the intellectual atmosphere of Europe, and to widen our horizon in all that pertained to the science of man, in history, philology, theology, and philosophy. The East, formerly a land of dreams, of fables and fairies, has become a land of unmistakeable reality; the curtain between the West and the East has been lifted, and their old forgotten home stands before them again in bright colours and definite outline. Before all, a study of the East has taught the same lesson which the northern nations once learnt in Rome and Athens, that there are other worlds beside our own, that there are other religions, other mythologies, other laws, and that the history of philosophy from Thales to Schlegel is not the whole history of human thought. In all these subjects the East had supplied parallels, and all that was implied in parallels, viz., the possibility of comparing, measuring, and understanding. The comparative spirit was the truly scientific spirit of the age, nay, of all ages. An empirical acquaintance with single facts did not constitute knowledge in the true sense of the word. He advocated the founding of chairs in our Universities for the languages and antiquities of various extinct and existing peoples, and spoke of the great service which properly educated missionaries might render as pioneers of scientific research. What I should like to see is this, he said: I should like to see ten or twenty of our non-resident fellowships, which at present are doing more harm than good, assigned to missionary work, to be given to young men who have taken their degree, and who, whether laymen or clergymen, are willing to work as assistant missionaries on distant stations; with the distinct understanding that they should devote some of their time to scientific work, whether the study of languages, or flowers, or stars, and that they should send home every year some account of their labours. These men would be like scientific consuls, to whom students at home might apply for information and help. Thirdly, Prof. Müller continued, I think that Oriental studies have a claim on the colonies and the colonial governments. The English colonies are scattered all over the globe, and many of them in localities where an immense deal of useful scientific work might be done, and would be done with the slightest encouragement from the local authorities, and something like a systematic supervision on the part of the Colonial Office at home. Now, we should bear in mind that at the present moment some of the tribes living in or near the English colonies in Australia, Polynesia, Africa, and America, are actually dying out, their languages are disappearing, their customs, traditions, and religions will soon be completely swept away. To the student of language the dialect of a savage tribe is as valuable as Sanskrit or Hebrew, nay, for the solution of certain problems, more so; every one of these languages is the growth of thousands and thousands of years, the workmanship of millions and millions of human beings. If they were now preserved they might hereafter fill the most critical gaps in the history of the human race. And this is not all. The study of savage tribes has assumed a new interest of late, when the question of the exact relation of man to the rest of the animal kingdom has again roused the passions, not only of scientific inquirers, but also of the public at large. Now, what is wanted for the solution of this question is more facts and fewer theories, and these facts can only be gained by a patient study of the lowest races of mankind.

At Dr. Birch's, who gave a reception in the afternoon at his official residence, an agreeable surprise awaited the guests. A secretary of legation had just arrived from the French Embassy, bearing an official and holograph letter to Dr. Birch from the Comte de Jarnac, and a handsome jewel-box, containing the rare and exceedingly honourable decoration of the Golden Palm Branches, or, to speak more correctly, the order of "Officier de l'Instruction Publique," a decoration only conferred upon persons of the highest scientific and literary merit, and confined to ten personages only.

The Hamitic Section assembled in the evening at the rooms of the Society of Biblical Architecture, Conduit Street. The most interesting paper was "On the Place of the Lake or Sea passed by the Israelites at the Exodus," by his Excellency Prof. Brugsch, in French. The author was listened to with rapt attention as he endeavoured to demonstrate that the Hebrews did not really cross the Red Sea, but between the Bitter Lakes lying to the north of the sea. This paper will be printed.

On Friday, the 18th, the Aryan and Archæological Sections met, and in each valuable papers were read.

In the afternoon of Saturday, the Ethnological Section, under the presidency of Prof. Owen, C.B., F.R.S., Superintendent of the Natural History Collections in the British Museum, met at the rooms of the Royal Asiatic Society, where a very large attendance was gathered to hear the interesting addresses of the distinguished president.

In illustration of contributions to the physical elements of ethnology, Prof. Owen referred to the five quarto volumes of photographic illustrations, with descriptions of the various castes, outcasts, traders and artisans, soldiers, outlaws, and primitive hill tribes of Hindostan, issued by the India Office, under the editorial care of Sir John William Kaye and Dr. Forbes Watson. To Dr. Mouatt, when in the Indian service, Prof. Owen had first been indebted for the materials of a report on the natives of the Andaman Islands, published by the British Association in 1861. The language of that dwarf Nigrito race had been well studied by Mr. Homfray, and additional information had been recorded by other scientific Indian officers, as by Surgeon Francis Day and the lamented F. Stoliczka. In a brief summary of present knowledge of the Nigrito and Papuan tribes the president laid stress upon the geological and collateral evidences of their origin on land trusts related in time to recent geological changes, to a period vastly remote in relation to historical time. Their interest to the ethnologist was the retention by certain, now insulated, groups of Nigritos, of an early – he would not say primitive—condition of humanity, like those of some pre-historic races in Europe. The shell-mounds of the Andaman Islands, *e.g.*, were compared with the "kitchen-middens," on North European shores. The Nigritos of the Andamans, like those of New Guinea, waged an unmitigated, uncompromising hostility, by force and fraud, against invaders. Such disposition was comparable to that which the brute species in their wild state bear to man. These Nigritos seem to realise instinctively their fate through contact with a higher race. Since the establishment of a penal settlement in the smaller of the Andaman Islands, kindly disposed ladies have taken in hand Mincopie girls; some swam back to the larger islands, others, retained and taught to the age of puberty, were returned to their tribe. They forthwith resumed its condition and cast off their garments. The men girt the abdomen, against pangs of hunger, with a flexible tendril; but in other respects these dwarf Nigritos exhibit quite a prelapsarian, or quadrumanous, unconsciousness of nakedness. After touching upon previous hypotheses that had been broached of the origin of Hill-men, Mincopies, and Papuans, the president summarised the observations on which he founded a recommendation to ethnologists to pause before concluding that the present disposition of land and sea was necessarily associated with the origin of such low forms of humanity, and to admit the possibility, if not probability, of its contemporaneity with the latest geological changes on the earth's surface. Prof. Owen then passed to the consideration of the origin, antiquity, and race-characters of the first scientifically known civilised people. This part of the discourse was illustrated by a diagram of the dynasties and reigns of Egyptian kings, and enlarged views from photographs of portrait-sculptures of individuals of the third and fourth dynasties, of a Hykshos Pharaoh of the sixteenth dynasty: of a monarch of the twentieth dynasty, belonging to the native race, after the expulsion of the "Shepherd Kings," and of Pharaohs of the Greek race, including one of Cleopatra, which, from the circumstances of its discovery, supported the belief of its being a true likeness of that queen. To ethnologists the greatest interest was attached to the evidences of the physiognomies of the race that founded the civilisation of ancient Egypt. They are supplied by statues of eminent individuals of well-to-do families, discovered in the temples connected with the tombs. Some are of wood, some of alabaster, some of granite; but the noblest of these is the statue of Chephren, the Phra, or Pharaoh of the fourth dynasty, who built the second of the great pyramids of Ghizeh. It was discovered by Mariette Bey in the temple contiguous to that mighty organised cairn or tomb. It is of life-size; the Pharaoh is seated on his throne, carved out of one block of the beautiful, intractable, and rare mineral called "diorite." Photographs of this statue were exhibited. The face, with features as refined and intellectual as those of a modern European, has a calm, dignified expression, free from the conventionality of the statues of later monarchs. The anatomy of the frame was as true as in works of art from the chisel of Michael Angelo. According to the "table" exhibited, this king lived B.C. 4200. The sculptor wrought thirty-seven centuries before Phidias. What was the period of incubation necessary to attain such perfection in both the creative and mechanical departments of the noblest of the arts? Prof. Owen then briefly discussed the evidence for this high antiquity. To the most philosophic and knowledge-loving of the kings of the Greek dynasty we owe the translation into Greek of the records written in the language, and entrusted to the care of the respective priesthoods of Egypt and of Judæa. Between these records there was great discrepancy. Egypt had risen from a long mythical period to become a state ruled by one mortal Phra, or king, at a period, according to Manetho, contemporaneous, according to Esdras, with the Creation! A later Pharaoh, Cheops, was, according to the Egyptian chronicle, building his pyramid at a time when, according to the Hebrew reckoning, the world was being submerged by the Flood. The attitude of the ethnologist, in the presence of the Manethonian and Septuagint documents, was plain; he has to put away any partiality towards one or other of the respective authors; any presumption of the superior claims of either to recognition; and to test them by facts open to discovery, and on which the truth-getting faculty can base scientific conclusions. This attitude in reference to the Hebrew record is taken by the "Palestine Exploration Fund." A like investigation of the remains of edifices, works of art, monumental records akin to the "Moabite Stone," geological and zoological phenomena, had been carried on in Egypt for a longer period and with richer results than elsewhere. Among the labourers in this monumental field the president more especially paid tribute to Lepsius and Mariette Bey. The testimonies bearing on Manetho's chronology were then briefly enumerated. From these the president inferred that if the Sebennyte priest had erred it was by omission rather than commission; and he expressed his conviction that the chronology set forth in the diagram best squared with the sum of scientific evidence on this important question. In the present palæontological evidence of the antiquity of the human race, 7,000 years seemed but a brief period to be allotted to the earliest civilised administratively-governed community; it seemed natural that such conditions should first have arisen in a land with such unique blessedness of soil and climate as Egypt; and with the high racial character of the people flourishing under its antediluvian Pharaohs. The question as to the origin of this race was then discussed; followed by remarks on the evidence of the periods required for the origin of the leading varieties of the human species. Some remarks on the evidences of the relative antiquity of Egyptian and Chaldæan civilisation followed; and the president concluded by appealing to his fellow Orientalists to cast aside prepossessions as to time, place, affinity, race, for which there may not be any groundwork of rightly observed well-determined data, and to bring to bear on the dark vistas of the past the pure, dry light of science.

Dr. Forbes Watson, M.A., read a most important scientific paper "On the establishment, in connection with the India Museum and Library, of an Indian Institute for Lecture, Inquiry, and Teaching, and on its Influence on the Promotion of Oriental Studies in England, on the Progress of Higher Education among the Natives of India, and on the Training of Candidates for the Civil Service of India."

The India Museum and Library, Dr. Watson said, would afford a most suitable nucleus for the organisation of a centre for Indian research and information. Such a purpose would be best effected by establishing in connection with the museum and library an institute for lecture, inquiry, and teaching on all Indian subjects. Such an institute would prove highly advantageous from every point of view. The chief object of all scientific institutions is the promotion of research and the dissemination of information—the increase of knowledge, and the increase in the number of people possessed of it. In either direction these institutions would prove more effective if combined than if separate. It is clear that the public usefulness of the museum and library would be extended by the lectures and teaching of the institute; and that the action of the institute on the other hand would be supplemented by its connection with the museum and library.

The following is the plan of arrangement for an Indian Museum which would divide the whole of its contents into a series of groups and sub-groups affording a connected view of the country and its people. This plan takes account of the library as well; in fact, with regard to some of the divisions, reference must be made to the library for a large portion of the materials, and with regard to others for the whole of them.

A. THE COUNTRY AND ITS RESOURCES.

1. *Physical Geography.*
    - *a.* Boundaries and Administrative divisions.
    - *b.* Orography.
    - *c.* Hydrography.
    - *d.* Meteorology.

2. *Natural History.*
    - *a.* Geology and Mineralogy.
    - *b.* Soil.
    - *c.* Flora.
    - *d.* Fauna.

3. *Agriculture, Manufactures, and Commerce.*
    - *a.* Raw produce, mining agriculture, forestry, &c.
    - *b.* Trade and manufactures.
    - *c.* Tools, machinery, processes.
    - *d.* Locomotion by land and water.
    - *e.* Harbours, lighthouses; docks, warehouses, fairs and markets, telegraph and postal communications.
    - *f.* Currency, banks, &c.
    - *g.* Coins, weights, and measures.

B. THE PEOPLE AND THEIR MORAL AND MATERIAL CONDITION.

4. *Ethnography.*
    - *a.* Races.
    - *b.* Castes and religious sects.
    - *c.* Population and vital statistics.

5. *History and Administration.*
    - *a.* Philology.
    - *b.* Archæology.
    - *c.* Mythology.
    - *d.* Historical Geography.
    - *e.* Political and Administrative History.
    - *f.* Legislation.
    - *g.* Current Administration.

6. *Domestic and Social Economy.*
    - *a.* Food and cooking.
    - *b.* Houses and buildings.
    - *c.* Clothing and personal decoration.
    - *d.* Manners and customs.
    - *e.* Health and sanitation.
    - *f.* Education.
    - *g.* Religion.
    - *h.* Fine and decorative art.
    - *i.* Science and literature.

Several other papers were taken as read, and the session of the Congress ended with the choice of St. Petersburg for the meeting of the Congress of 1875. In the evening the Lord Mayor entertained the members at a magnificent banquet at the Mansion House.

COMMON WILD FLOWERS CONSIDERED IN RELATION TO INSECTS *

II.

THE Common Heaths (*Erica tetralix* and *E. cinerea*) offer us another very ingenious arrangement. In *E. tetralix* (the Cross-leaved Heath), for instance, the flower is in the form of a bell (Fig. 15), which hangs with its mouth downwards, and is almost closed by the pistil (*st*), which represents the clapper. The stamens are eight in number, and each terminates in two cells, which diverge slightly, and have at their lower end an oval opening. But though this opening is at the lower end of the anther cells the pollen cannot fall out, because each cell, just where the opening is situated, touches the next anther cell, and the series of anthers thus form a circle surrounding the pistil and not far from the centre of the bell. Each anther cell also sends out a long process, which thus forms a series of spokes, standing out from the circle of anthers. Under these circumstances, a bee endeavouring to suck the honey from the nectary cannot fail firstly to bring its head in contact with the viscid stigma, and thus to deposit upon it any pollen derived from a previous visit; and secondly, in thrusting its proboscis up the bell, it inevitably comes in contact with one of the anther processes, which acts like a lever and dislocates the whole chain of anther cells when a shower of pollen falls from the open anther cells on to the head of the bee. †

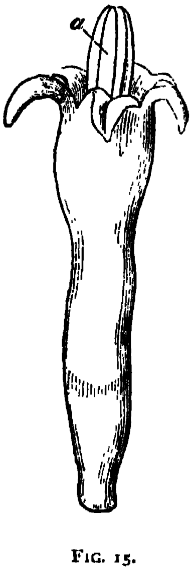

FIG. 15.

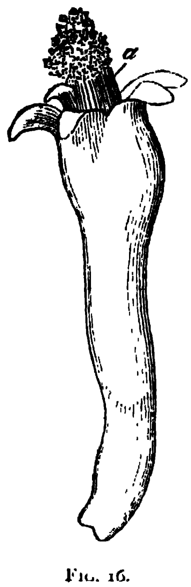

FIG. 16.

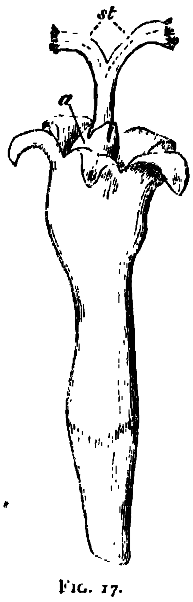

FIG. 17.

In the allied genus Vaccinium there is a similar arrangement, but the anther cells are closed, not by touching one another, but by resting against the style, so that the style itself closes the openings until the anthers are distributed by the proboscis of the bee. *V. uliginosum* is much larger than *V. myrtillus*, and consequently more conspicuous; *V. myrtillus*, on the other hand, has the compensating advantage of being richer in honey.

The genus Arbutus also is said to agree in essentials with Vaccinium.

In many cases the effect of the colouring and scent is greatly enhanced by the association of several flowers on one branch or raceme, as, for instance, in the Wild Hyacinth, the Lilac, and othe rfamiliar instances. In the great family of Umbelliferæ this arrangement is still further taken advantage of, as in the common Wild Chervil (*Cherophyllum sylvestre*).

In this group the honey is not, as in the flowers just described, situated at the bottom of a tube, but lies exposed, and is therefore accessible to a great variety of small insects. The union of the florets into a head is, moreover, not only of advantage in rendering them more conspicuous, but also effects a considerable saving of time, as it enables the insects to visit a given number of insects more rapidly, and consequently renders their fertilisation more certain than if they had stood singly.

The self-fertilisation which, in small flowers such as these, would otherwise naturally occur, is provided against by the fact that the flowers are generally proterandrous, that is to say, the stamens ripen before the pistil, and the latter is not mature until the former have shed their pollen. In some cases, as, for instance, in Myrrhis, the flowers of one head are all firstly in the male condition, and subsequently in that with mature stigmas, none of them arriving at the second stage until they have all passed through the first.

In *Cherophyllum* the petals are not symmetrical, the outer ones being considerably larger than the others, and in many umbellifers the florets themselves on the outer edge of the bunch or umbel are considerably larger than the inner ones.

This distinction is carried still further in the Compositæ, where also the florets are so closely packed together that the whole umbel is commonly, though of course incorrectly, spoken of as a flower.

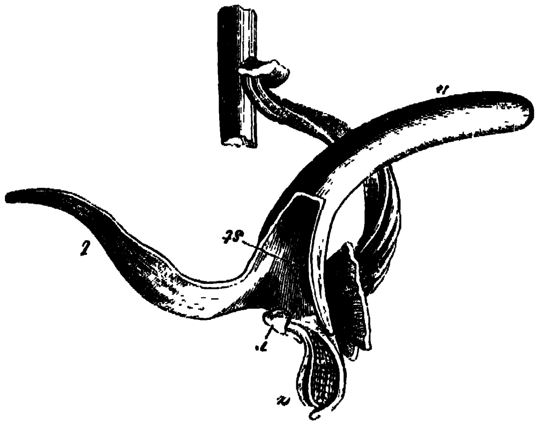

FIG. 18.

For instance, the heads of the common Daisy, as I need hardly mention, are not strictly speaking flowers, but bunches of flowers closely packed together on a common base or receptacle.

The advantages of this arrangement are :—

1. That the flowers become much more conspicuous than would be the case if they were arranged singly.
2. That the facility with which the honey is obtained renders them more attractive to insects.
3. That the visits of the insects are more likely to be effectual, since the chances are that an insect which once alights, touches several, if not many, florets.

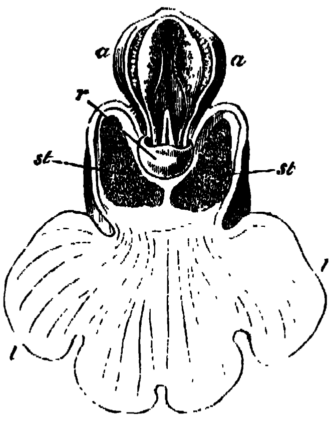

FIG. 19.

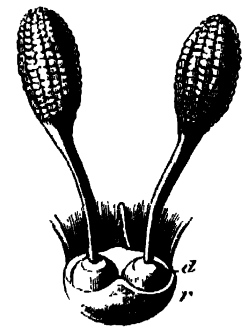

FIG. 20.

No wonder, therefore, that the Compositæ are the most extensive family among flowering plants, are represented in every quarter of the globe and in every description of station,* and contain nearly ten thousand species.

If we take, for example, the common Feverfew, or large white Daisy (*Chrysanthemum parthenium*), which has been well described by Dr. Ogle,† the flower-heads consist of an outer row of female florets, in which the tubular corolla terminates on the outer side in a white leaf or ray, which doubtless is useful in making the flower conspicuous. The inner florets are also tubular, but are small, yellow, and without rays. Each of these florets is furnished with stamens as well as a pistil. The stamens are united on their inner sides so as to form a closed tube, within which the pistil lies. They ripen before the pistil, and dehisce on their inner sides, so that the pollen is discharged into the upper end of the tube above the head of the pistil. When the flower opens the pollen is already ripe, and fills the upper part of the stamen tube. A floret in this condition is represented in Fig. 15. The pistil, however, also continues to elongate, and at length pushes the pollen against the upper end of the tube, which gives way, and thus the pollen is forced out of the tube, as shown in Fig. 16. The pistil itself terminates in two branches, which at first are pressed closely to one another, and each of which terminates in a brush of hairs (Fig. 17). As the style elongates this brush of hairs sweeps the pollen cleanly out of the tube, and it is then removed by insects. When the pistil has attained its full length two branches open and curve downwards so as to expose the stigmatic surfaces (Fig. 17, *st*) which had previously been pressed closely to one another, and thus protected from the action of the pollen. From this arrangement it is obvious that any insect alighting on the flower-head of the Chrysanthemum would dust its under-side with the pollen of the younger flowers, which then could not fail to be brought into contact with the stigmatic surfaces of the older ones. As the expansion of the flowers begins at the outside and thence extends to the centre, it is plain that the pollen of any given floret cannot be used to fertilise one situated on its inner side. Consequently, if the outer row of florets produced pollen, it would, in the great majority of cases, be wasted. I have, however, already mentioned that these florets do not produce pollen, while the saving thus effected enables them to produce a larger corolla. It is also interesting to observe that in these outer flowers the branches of the pistil do not possess the terminal brush of hairs which, in the absence of pollen, would be useless.

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* Continued from p. 406.

† *Popular Science Review*, April 1870.

* Bentham, "Handbook of the British Flora," vol i. p. 408; Jour. Linn. Soc. 1873, p. 335.

† *Popular Science Review*, April 1870.

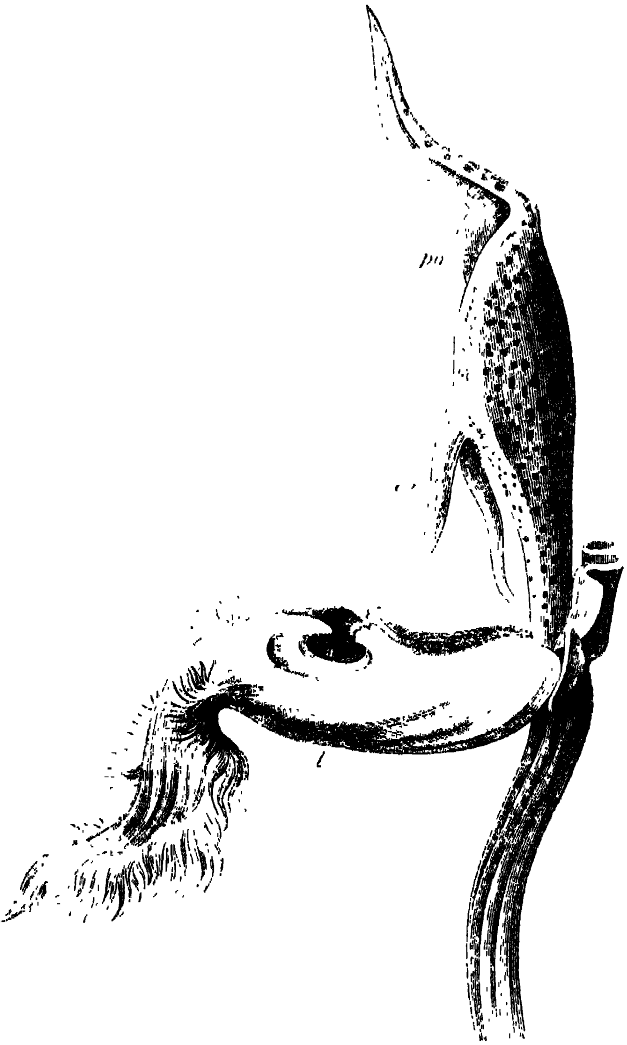

FIG. 21.

In other Compositæ, as in the Marigold, while the ray flowers produce no pollen, the disc flowers develop stigmas only. In this case, as in the Feverfew, the pistil of the ray flowers does not require or possess the terminal brushes of hairs, as there is no pollen to be swept out. The central flowers, on the other hand, though they develope no stigmas, require a pistil in order to force the pollen out of the anther tube. Hence the pistil is present as usual, but the head is simple and not bifid. This complete alteration of the function of the pistil is extremely curious

Perhaps no group of flowers offers more remarkable adaptations than the orchids, which have been so admirably described by Mr. Darwin.* As an illustration of our English species, I shall take the common early purple orchis (*Orchis mascula*), as being one of the commonest, if not the commonest, species; and a fair example of some of the remainder, which however differs in many interesting and important points.

Fig. 18 represents the side view of a flower, from which all the petals and sepals have been removed, except the labellum (*l*), half of which has been cut away, as well as the upper portion of the near side of the nectary (*n*). The pollen forms two masses (Fig. 19, *a a*), each attached to a tapering stalk, which gives the whole an elongated pear-like form, and is attached to a round sticky disk (*d*), which lies loosely in a cap-shaped envelope or rostellum (*r*). This envelope is at first continuous, but the slightest touch causes it to rupture transversely, and thus to expose the two viscid balls (Fig. 20, *d*). Now suppose an insect visiting this flower; it alights on the labellum, and pushing its proboscis down the nectary to the honey, it can hardly fail to bring the base of the proboscis into contact with the two viscid discs, which at once adhere to it, so that when the insect draws back its proboscis, it carries away the two pollen masses. It is easy to imitate this with a piece of grass, and to carry away on it the two pollen masses and their stalks. If, however, the pollinium retained this erect position when the insect came to the next flower, it would simply be pushed into or against its old position. Instead however of remaining upright, the pollinia, by the contraction of the minute disc of membrane to which they are attached, gradually turn downwards and forwards, and thus when the insect sucks the next flower, the thick end of the club exactly strikes the stigmatic surface (*st*). The pollinium or pollen mass consists of packets of pollen grains, fastened together by elastic threads. The stigma, however, is so viscid, that it pulls off some of these packets, and ruptures the threads, without removing the whole pollinium; so that one pollinium can fertilise several flowers.

I cannot resist mentioning the case of Catasetum, one of the Vaudræ, which, as Mr. Darwin says, "are the most remarkable of all orchids." In Catasetum (Fig. 21) the pollinia and the stigmatic surfaces are in different flowers, hence it is certain that the former must be carried to the latter by the agency of insects. The pollinia, moreover, are furnished with a viscid disc, as in orchis, but from the large size of the flower, and the position of the honey, the insect has no inducement to approach, and in fact does not touch, the viscid disc. The flower, however, is endowed with a peculiar sensitiveness, and actually throws the pollinium at the insect. Mr. Darwin has been so good as to irritate one of these flowers in my presence: the pollinium was thrown nearly 3 ft., when it struck and adhered to the pane of a window. This irritability, however, is confined to certain parts of the flower of *Catasetum saccatum*, which is also shown in section in Fig. 22. In this figure it will be seen that the pollinium (*dp*) is curved, and in a state of considerable tension, but retained in that position by a delicate membrane. Now, insects alight as usual on the labellum of the flower (*l*), and it will be seen that in front of it are two long processes, or antennæ (*an*). In some species of Catasetum both these antennæ are highly irritable; in the present species the right-hand one is apparently functionless; but the moment the insect touches the left-hand one, the excitement is conveyed along it, the membrane retaining the pollinium is ruptured, and the latter is immediately jerked out of the flower by its own elasticity, with considerable force, with the viscid disc foremost, and in such a direction as to come in contact with the head of the insect which had touched the antenna.

I will only mention one other tropical flower, the very curious *Marcgravia nepenthoides*, described by Mr. Belt in his interesting work, "The Naturalist in Nicaragua." The flowers are disposed in a circle, and beneath them are suspended some pitcher-like vessels, which secrete a sweetish liquid, and thus attract numerous insects. These again bring birds, which can hardly fail to brush against the flowers, and thus convey the pollen from one to the other.

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* Fertilisation of Orchids.

In the flowers hitherto described, while the several species offer the most diverse arrangements, we have met with no differences within the limits of the same species, excepting those dependent upon sex. I must now call attention to some cases in which the same species possesses flowers of two or more kinds, which sometimes, as in the Violet, are adapted to different conditions; but more frequently are so constituted as to ensure cross-fertilisation.

In some of the violets (*V. odorata*, *canina*, &c.), besides the blue flowers with which we are all so familiar, but which produce very little seed, there are other autumnal flowers, almost without petals and stamens, and which indeed have none of the appearance of true flowers, but in which the seeds are produced. As these curious flowers, however, have no relation to our present subject, I shall not now dwell on them.

I pass on to the genus Primula, which offers a most interesting case of dimorphism. The Cowslip and Primrose resemble one another in many respects, though the honey they secrete must be very different, for while the Cowslip is habitually visited during the day by humble bees, this is not the case with the Primrose, which, in Mr. Darwin's opinion, is fertilised almost exclusively by moths. (Jour. Linn. Soc., vol. x. p. 438.) This, however, is a digression.

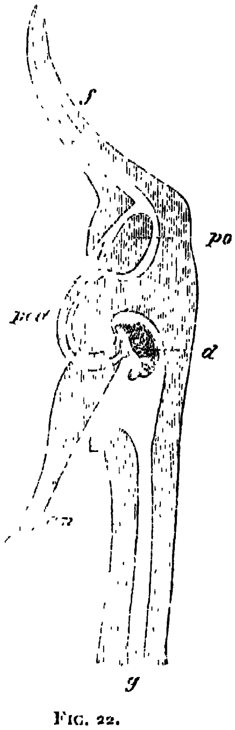

FIG. 22.

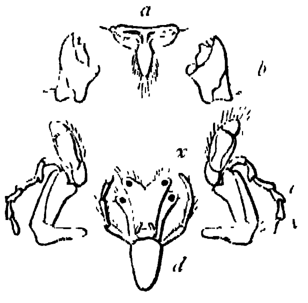

FIG. 23.

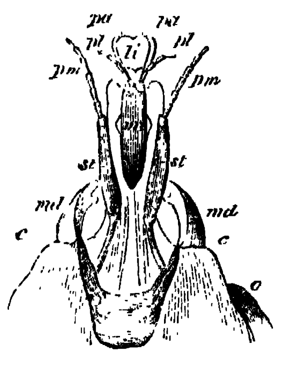

FIG. 24.

Corresponding differences occur in the Polyanthus and Auricula, and had long been known to gardeners, and even to school children (by whom the two kinds of flowers are known as "pin-eyed" and "thumb-eyed"), but it was reserved for the genius and perseverance of Mr. Darwin, to explain * the significance of this curious phenomenon, and the important part it plays in the economy of the flower. Now that Mr. Darwin has pointed this out it is sufficiently obvious: an insect thrusting its proboscis down a primrose of the long-styled form would dust its proboscis apart, which, when it visited a short-styled flower would come just opposite the head of the pistil, and could not fail to deposit some of the pollen on the stigma. Conversely an insect visiting a short-styled plant would dust its proboscis at a part further from the tip, and which, when it subsequently visited a long-styled flower, would again come just opposite to the head of the pistil. Hence we see that by this beautiful arrangement insects will carry the pollen of the long-styled form to the short-styled, and *vice versâ*.

There are other points in which the two forms differ from one another: for instance, the stigma of the long-styled form is globular and rough, while that of the short-styled is smoother, and somewhat depressed. The pollen of the two forms is also dissimilar, that of the long-styled being considerably smaller than the other, 7-7000ths of an inch in diameter against $\frac{10-11}{7000}$ or nearly in the proportion of three to two; a difference the importance of which is obvious, for each has to give rise to a tube which penetrates the whole length of the style, from the stigma to the base of the flower, and the tube in the long-styled form must therefore be nearly twice as long as in the other. Mr. Darwin has shown that much more seed is set if pollen from the one form is placed on the pistil of the other, than if the flower is fertilised by pollen of the same form, even if taken from a different plant. Nay, what is most remarkable, such unions in Primula are more sterile than crosses between distinct, though nearly allied species of plants, have in some cases been found to be.

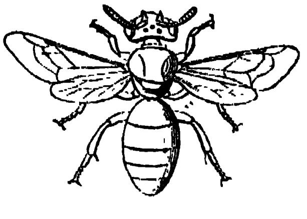

FIG. 25.

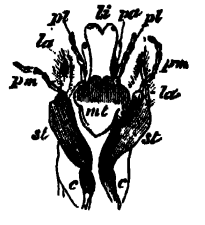

FIG. 26.

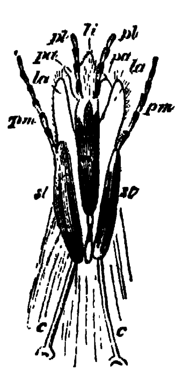

FIG. 27.

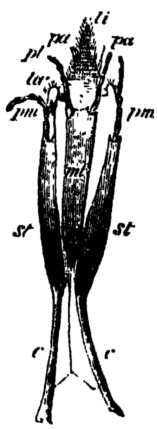

FIG. 28.

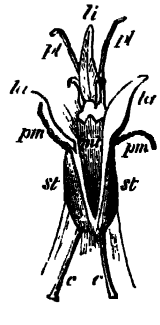

FIG. 29.

The majority of species of the genus Primula appear to be dimorphic, but not all.*

Mr. Darwin has pointed out † that several species of Linium are dimorphic in the same manner as the Cowslip and Primrose. *Lythrum salicaria*, however, ‡ is even more remarkable, since as was remarked by Vaucher, but first explained by Mr. Darwin, it presents us with three distinct forms (each contain-

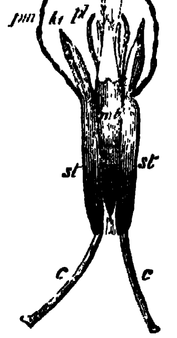

FIG. 30.

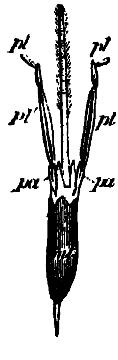

FIG. 31.

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* *Linnean Journal*, 1862, p. 77.

* Scott, Proc. Linn. Soc., vol. viii., 1864, p. 80.
† Jour. Linn. Soc., 1863, p. 69.
‡ Linn. Jour. 1864, p. 169.

ing a pistil and two groups of stamens), which he calls, from the relative lengths of their pistils, the long-styled, mid-styled, and short-styled. In this species, also, it is remarkable that the seeds of the three forms differ from one another, 100 of the long-styled seeds being equal to 121 mid-styled or 142 short-styled. The pollen grains also not only differ in size (the long stamens having the largest-sized pollen grains, the middle-sized stamens middle-sized pollen grains, and the short stamens small pollen grains), but also in colour, being green in the longer stamens, and yellow in the shorter ones; while the filaments are pink in the long stamens, uncoloured in the shorter ones. Mr. Darwin has also proved by experiment that this species does not set its seeds, if the visits of insects ares prevented; in a state of nature, however, the plant is much frequented by bees, humble-bees, and flies, which always alight on the upper side of the flowers in the stamens and pistil.

He has also shown that in this species, as in Primula, perfect fertility can only be obtained by fertilising each form with pollen from stamens of corresponding length. This case is indeed most complex, as the pollen of each set of stamens, when applied to the same stigma, acts most differently, and it would appear that the greater the inequality in length between the pistil and stamens, the greater the sterility.

The genus Lythrum is also remarkable for the great differences existing between different species. *L. græfferi*, like *L. salicaria*, is trimorphic; while *L. thymifolia* is dimorphic; and *L. hyssopifolia* is homomorphic.

Let us consider the manner in which the bees are adapted to the flowers. Although we may in one respect say that the general organisation of the insect is modified with reference to these relations, still, as Müller, from whom the following facts are mainly taken, has well shown, the parts which have been the most profoundly modified are the mouth and the legs. If we are asked why we assume that in this case the mouth-parts and legs have been modified, the answer is that they depart greatly from the type found in allied insects, and that between this type and these modified examples various gradations are to be found.

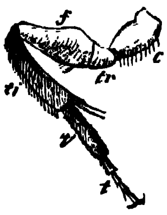

FIG. 32.

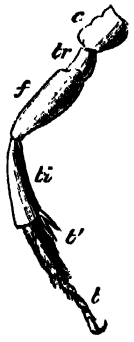

FIG. 33.

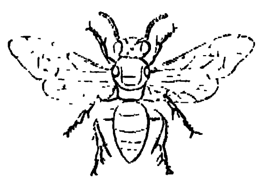

FIG. 34.

The mouth of an insect, say of a wasp (Fig. 23), is composed of (1) an upper lip, *a*, (2) an underlip, *d*, (3) a pair of anterior jaws or mandibles, *b*, and (4) a pair of posterior jaws or maxillæ, *c*. These two pairs of jaws work laterally, that is to say, from side to side, and not as in man and other mammalia, from above to below. The lower lip and maxillæ are each provided with a pair of feelers or palpi (*c* and *d*, *x*). The above figures represent the mouth-parts of a wasp, in which, as is very usually the case, the mandibles are hard and horny, while the maxillæ are more delicate and membranous. In the different groups of insects these organs present, however, almost infinite variations.

Fig. 24 represents the mouth-parts of a bee, Prosopis (Fig. 25). The bees belonging to this genus construct their cells in sand, or in dry bramble sticks, lining them with a transparent mucus, which they smooth down with their trowel-like lower lip and which hardens into a thin membrane. That the mouth of Prosopis probably represents the condition of that of the ancestors of the hive-bees before their mouthparts underwent special modifications, may be inferred from the fact that the same type occurs in other allied groups, as is shown in Fig. 26, which represents the mouth of a wasp (Polistes), also seen from below.

We may therefore consider that Prosopis shows us special adaptation for the acquirement of honey, and in fact though the bees belonging to this genus feed their young on honey and pollen, they can only get the former from those flowers in which it is on the surface. In Andrena (Fig. 27), Halictus (Fig. 28), Panurgus (Fig. 29), Halictoides (Fig. 30), and Chelostoma (Fig. 31), we see various stages in the elongation of the lower lip until at length it reaches the remarkable and extreme form which it now presents in the hive- and humble-bees, and which enable them to extract the honey from most of our wild flowers, though no bees have the proboscis so much elongated as is the case with some butterflies and moths; perhaps as Hermann Müller has suggested, because the necessity of using their mouths for certain domestic purposes has limited its specialisation in this particular direction.

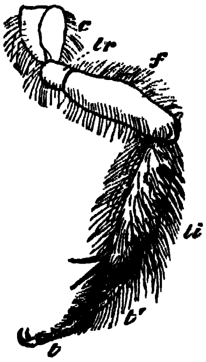

FIG. 35.

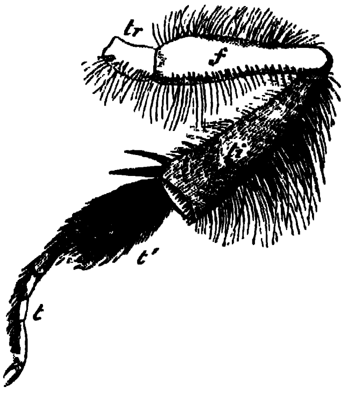

FIG. 36.

There are several flowers which are inaccessible to hive-bees, and to *Bombus terrestris*, which has a shorter proboscis than some of the other species belonging to that genus. Hermann Müller mentions, for instance, that he has often seen *Bombus terrestris* endeavouring, in vain, to suck the flowers of the Oxlip (*Primula elatior*). Having satisfied themselves that they were unable to do so, but not till then, they proceeded to cut a hole in the base of the tube, and thus arrived at the honey. This seems to show, he observes, that they act upon the results of experience, and not by what is called mere instinct. Indeed any one who has watched bees in greenhouses will see that they are neither confined by original instinct to special flowers, nor do they visit all flowers indifferently. Müller mentions several cases in which he has seen honeyless flowers visited by insects; *Genista tinctoria*, for instance, is frequently visited by insects in search of honey although it does not contain any.

Certain insects, on the other hand, confine themselves to particular flowers. Thus, according to H. Müller,

Andrena florea	visits exclusively	*Bryonia dioica*,
Halictoides	,, ,,	species of *Campanula*,
Andrena hattorfiana	,, ,,	*Scabiosa arrensis*,
Cilissa melanara	,, ,,	*Lytterum salicaria*,
Macropis labiata	,, ,,	*Lysimachia vulgaris*,
Osmia adunca	,, ,,	*Echium*.

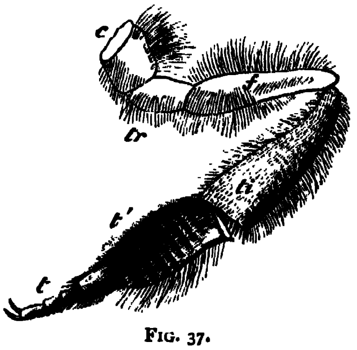

FIG. 37.

It would also appear that individual bees differ somewhat in their mode of treating flowers. Some humble bees suck the honey of the French Bean and the Scarlet Runner in the legitimate manner, while others cut a hole in the tube and thus reach it surreptitiously; and Dr. Ogle has observed that when he followed any particular bee she always proceeded in the same manner; some always entering by the mouth, others always cutting a hole. He particularly mentions that this was the case with bees of one and the same species, and infers, therefore, that they differ from one another in their degrees of intelligence; and his observations, though of course not conclusive, are interesting and suggestive.

If again we examine the hind legs of bees, we shall find similar gradations. In Prosopis (Fig. 32) they do not differ materially from those of genera which supply their young with animal food. Portions of the leg, indeed, bear stiff hairs, the original use of which probably was to clean this burrowing insect from particles of sand and earth, but which in Prosopis assist also in the collection of pollen.

Fig. 33 represents the hind leg of Sphecodes (Fig. 34), a genus in which the tongue resembles in form that of Halictus. Here we see the hairs decidedly more developed, a modification which has advanced still further in Halictus (Fig. 35), in which we see that the development of the hairs is most marked on those segments of the hind legs which are most conveniently situated for the collection and transport of pollen.

In Panurgus the same change is still more marked, and the pollen-bearing apparatus is confined to the tibiæ and first segment of the tarsus, a differentiation which is even more apparent in Anthophora. In these bees the pollen is simply entangled in the hairs of the leg as in a brush, but there are other genera, as for instance the humble bees and the hive bee, which moisten the pollen with honey, and thus form it into a sticky mass, which is much more easy to carry, and is borne, not round the leg, but on one side of it. In the humble bee (Bombus, Fig. 36), for instance, the honey is borne on the outer side of the hinder tibiæ, which are flattened, smoothed, and bordered by a row of stiff curved hairs, which thus constitute it a sort of little basket. Lastly, in the hive bee (Fig. 37), the adaptation is still more complete, the hairs on the first tarsal segment are no longer scattered, but are arranged in regular rows; and the tibial spurs inherited by Bombus from far-distant ancestors have entirely disappeared.

In some bees the pollen is collected on the body, and here also we find a remarkable gradation from Prosopis, which has only minute and simple hairs, like a wasp; through Sphecodes, a Nomada, in which the longer hairs are still few, and generally simple, though some few are feathered; to Andrena and Halictus, where the hairs are much more developed; a change which is more marked in Sarapoda, Colletes, and Megachile; still more so in Osmia and Anthophora; until we come to the humble bees, in which the whole body is covered with long feathered hairs.

Although flowers present us with all these beautiful and complex contrivances, whereby the transfer of pollen from flower to flower is provided for and waste is prevented, yet they are imperfect, or at least not yet perfect, in their adaptations. Many small insects obtain access to flowers and rob them of their contents. *Malva rotundifolia* can be, and often is, sucked by bees from the outside, in which case the flower derives no advantage from the visit of the insect. In *Medicago sativa*, also, insects can suck the honey without effecting fertilisation, and the same flower continues to secrete honey after fertilisation has taken place, and when apparently it can no longer be of any use. Fritz Muller has observed that, though *Posoqueria fragrans* is exclusively fertilised by night-flying insects, many of the flowers open in the day, and consequently remain sterile.

It is of course possible that these cases may be explained away; nevertheless, as both insects and flowers are continually altering in their structure and in their geographical distribution, we should necessarily expect to find such instances. Animals and plants constantly tend to adapt themselves to their conditions, just as water tends to find its own level.

I have been good-humouredly accused of attacking the little busy bee, because I have attempted to show that it does not possess all the high qualities which have been popularly and poetically ascribed to it. But if scientific observations do not altogether support this intellectual eminence, which has been ascribed to bees, they have made known to us in the economy of the hive many curious peculiarities which no poet had ever dreamt of, and have shown that bees and other insects have an importance as regards flowers which had been previously unsuspected. To them we owe the beauties of our gardens, the sweetness of our fields. To them flowers are indebted for their scent and colour, nay, their very existence in its present form. Not only have the brilliant colours, the sweet scent, and the honey of flowers been gradually developed by the unconscious selection of insects, but the very arrangement of the colours; the circular bands and radiating lines, the form, size, and position of the petals, the arrangement of the stamens and pistil, are all arranged with reference to the visits of insects, and in such a manner as to ensure the grand object which renders these visits necessary.

Thus, then, I have attempted to point out some of the relations which exist between insects and our common wild flowers; the whole subject is one, however, which will repay most careful attention, for, as Müller has truly said, there is no single species the whole history of which is yet by any means thoroughly known to us, and while, with reference to the regions of thought brought before us by the president on Wednesday evening, few can hope themselves to assist in the progress of truth, the case is very different with reference to my subject of this evening, in which every one of us by care and perseverance may fairly hope to add something to the sum of human knowledge.

NOTES

We hear that it is most probable that Dr. T. Lauder Brunton, F.R.S., whose investigations in the science of therapeutics have made him so well known to physiologists and pathologists generally, will undertake the editorship of the *Practitioner*, rendered vacant by the death of Dr. Anstie.

The forty-seventh congress of German naturalists and physicists opened at Breslau on Sept. 18. The proceedings were opened by the eminent chemist, Prof. Loewig, who expressed his satisfaction at seeing so many foreigners, whose presence in that assembly, he added, was a living testimony to the truth that science was of no country. Capt. von Dechen read a paper upon the present state and the future prospects of geology. After him, Prof. Virchow, of Berlin, spoke upon miracles regarded from the scientific standpoint. The several sections were then constituted, and the members of the congress afterwards adjourned to a banquet. In the evening an open-air entertainment was given by the city, and a telegraphic greeting was sent to the Emperor.

The fortieth congress of the French Institute of the Provinces, *Les Mondes* informs us, opened at Rodez on Monday last, under the presidency of M. de Toulouse-Lautrec, and will last ten days. There are five sections, in which questions are discussed connected with the mathematical, physical, and natural sciences, agriculture, industry and commerce, anthropology and the medical sciences, history and archæology, philosophy, literature, the fine arts, and social economy. This is certainly comprehensive enough.

The last expedition for observing the transit of Venus is now on the point of leaving England for Egypt. It has developed into one of considerably greater magnitude than was at first intended. The Government expedition organised by Sir George Airy, instead of being located at Alexandria, will have its headquarters at Cairo, the longitude of which city is to be found by exchange of telegraph signals with Greenwich, for which purpose a branch station will be established for a time at Alexandria. For the actual observation of the transit, Cairo, Thebes, and Suez are selected, the longitude of the last two being obtained by exchanging telegraph signals with Cairo. The photographic branch of the enterprise will probably be at Thebes. Private expeditions have been organised, all of them in concert with the English Government one. The whole may be enumerated as follows:—English Government Expedition.—Chief captain, C. Orde Browne; photographic branch, Capt. Abney; astronomers, Mr. S. Hunter and Mr. Newton. Prof. Döllen, the Russian astronomer, and Col. Campbell have organised private expeditions to Thebes. Dr. Anvers proposes to be either at Cairo or Thebes, and Admiral Ommanney may also join the English party as an associate astronomer. The whole of the telescopes and huts from Greenwich are now on board the Peninsular and Oriental vessel *Hindostan*, which is to leave Southampton on the 1st proximo.

MR. LOUIS SEEBOHM, one of the chief photographers who embarked on the *Swatara* in June last as a member of the American Transit of Venus expedition, died at Bahia on July 22. He had been extremely ill during the voyage, and was ordered home by the medical officer of the vessel, but died of fever before he could be removed.

THE October number of Petermann's *Mittheilungen* will contain a valuable paper by Prof. H. Fritz on the geographical extension of the Aurora Borealis; the accompanying map, which contains the magnetic meridians, shows by a system of curves the places on the earth's surface from which the light is seen with equal frequency. Also a fine map of Haiti on the scale of $\frac{1}{1100000}$, with accompanying description; and the continuation of Dr. Nachtigal's contribution on the tributaries of the kingdom of Baghirmi, in which he gives some account of the fauna and flora of the region and of the manners, customs, and condition of the people. There is also a paper translated from the Russian of L. Kostenko, giving a personal account of the country between Khiva and Fort Kasala on the Sir-Daria.

A MOVEMENT is on foot among the students of the University of St. Andrews with the object of electing Mr. Darwin to the Rectorial chair in the room of Lord Neaves, who retires in November. On the last occasion a large number of the students were favourable to the election of a scientific man in the person of Prof. Huxley, and as he lost his election by only three votes, the Darwinians are encouraged to prosecute the candidature of their nominee. The election will take place on the fourth Thursday of November.

THE *Daily News* of Saturday last has a letter, dated Kandavan, Aug. 8, from its correspondent with the *Challenger*, giving an account of a short cruise from Wellington, New Zealand, which was left on July 6, to the Fiji Islands. The trawling and dredging was very successful, and many zoological and botanical specimens have been obtained. Among the treasures obtained by the trawl was a live nautilus, the only one caught alive since the ship left England. The *Challenger* was to proceed to the New Hebrides and Torres Straits, where it was expected to arrive about the beginning of this month.

M. CORENWINDER has contributed to a recent meeting of the Société des Sciences of Lille an exhaustive series of observations on the processes of respiration and nutrition in plants. He supports M. Claude Bernard's view, that the process ordinarily known as the respiration of plants—the decomposition of the carbonic acid of the atmosphere—is really a process of digestion, and that simultaneously with this, plants carry on, by day as well as by night, a true process of respiration, similar in all respects to that performed by animals, consisting in an oxidation of the carbonaceous matters of their tissues. By a very careful series of analyses, performed mainly on the lilac and maple, M. Corenwinder determined that the proportion of nitrogenous matter in the leaves gradually and progressively diminishes from the time that they emerge from the bud till their fall; the proportion of carbonaceous matter increases very rapidly during April and May, and then remains nearly stationary till October; while that of incombustible substance increases during the whole period of vegetation. He distinguishes, therefore, two periods in the vegetative season of the plant—the first period, when nitrogenous constituents predominate, is that during which respiration is the most active; the second, when the proportion of carbonaceous substance is relatively larger, is the period when respiration is comparatively feeble, the carbonic acid evolved being again almost entirely taken up by the chlorophyll, decomposed, and the carbon fixed in the true process of digestion.

PROF. H. HOFFMANN of Giessen has made some interesting experiments on the permanence of varietal and specific characters in the case of the French Bean and Scarlet Runner (*Phaseolus vulgaris* and *multiflorus*). A very large number of attempts to fix special varieties which were casually produced invariably failed, the tendency towards reversion to the ancestral form being apparently irresistible. On the other hand, no one of the characters which are ordinarily relied on to distinguish the two species from one another is constant, but is liable, under certain circumstances, to disappear. Dr. Hoffmann has also made a similar series of experiments on the Common Red Poppy (*Papaver Rhœas*). Constant cultivation for six years produced no perceptible variation; but in the seventh year several varieties in the colour, and in the next year in the form of the petals, made their appearance, tending towards an assimilation to *P. dubium*.

THE *Gardener's Chronicle* announces a new material for paper in a well-known American grass, *Zizania aquatica*. It is stated that the Zizania yields fully as much of the raw material as esparto, and has the great and peculiar merit of being comparatively free from silicates. Paper made from it is quite as strong and quite as flexible as that made from rags; it is easily bleached, economical in respect of chemicals, pure in colour, and remarkably free from specks and blemishes. It is especially recommended for the manufacture of printing paper. The grass grows in enormous quantities in our Canadian Dominion, on the shores of Lakes Erie, St. Clair, Ontario, &c., and it is affirmed that a supply of 100,000 tons annually may be looked on as certain. Its habitat is swamps, ponds, and shallow streams, where it grows to a height of from 7 to 8, or even to 12 and 14 ft. The structure is similar to that of rice, except that the flowers are unisexual. The grains are largely used as an article of food by the native Indians, some tribes depending on them to a large extent for their subsistence. The flavour is said to be superior to that of most other cereals, and it has long been known from these properties as "Canada Rice."

THE will of the late Girolamo Ponti, of Milan, which has just been published in the *London Gazette* by order of Lord Derby, is likely to give rise to some trouble before it can be carried into effect. The testator has bequeathed a considerable portion of his property to the "Academies of Science of London, Paris, and Vienna," to be divided among them in equal proportions, for the purpose in each case of founding, with the proceeds resulting from investment, two competitions yearly on the subjects of Mechanics, Agriculture, Physics and Chemistry, Travels by Sea and Land, and Literature. The committees to be appointed by the societies are instructed to give preference to those competitors who will have advanced any of the subjects mentioned by original discovery. The relatives of Signor Ponti are to dispute the will, and those London societies that think they have claims upon the legacy are urged to bring them forward at once. There can be no doubt which societies are meant in the case of Paris and Vienna; and at first sight there appears to be little doubt as to what body the title of "Academy of Science of London" would most appropriately apply.

AT the meeting of the Paris Academy of Sciences held Sept. 14, Dr. A. W. Hofmann announced that his two students, MM. Tiemann and Haarmann, who had obtained vanilline (the aromatic principle of the vanilla bean) from pine sap, propose to manufacture this substance on a large scale. The sap of a tree of medium height gives vanilline to the value of 100 fr., and the wood is not injured by the extraction of the sap. This will be the second vegetable product manufactured by purely chemical methods.

THE first fungus exhibition held in Scotland was opened in Aberdeen on Friday. The idea of the exhibition was first suggested by the Rev. Mr. Ferguson, of New Pitsligo, in the *Scottish Naturalist* for April. The suggestion was readily taken up by fungologists and men of science, and the result was an exhibition which those entitled to speak with authority say was never equalled in this country. The specimens numbered about 7,000. Almost every county in Scotland made large contributions, while England and Wales sent a number of exhibits. In fact, almost every fungologist in Britain contributed specimens.

In an address on Education at Rochdale on Saturday, Mr. Jacob Bright urged the claims of Owens College, Manchester, to assistance from the national exchequer, and hinted that a time was approaching when the enormous revenues of Oxford and Cambridge would be made more productive to the country.

The members of the *Tegethoff* Austrian Polar Expedition have arrived at Hamburg. They everywhere in Norway met with a very cordial welcome. The new country, as far as explored, comprises five islands, and contains hares and foxes. When rescued, the members of the expedition were in rags, and for a fortnight had been short of provisions and of firing. They were compelled to shoot all the sledge dogs, as the animals showed signs of madness. The members of the expedition will, it is expected, reach Vienna to-morrow.

A notice has been issued from the Science and Art Department that the Classes in Chemistry (Prof. Frankland), Biology (Prof. Huxley), Physics (Prof. F. Guthrie), and Applied Mechanics (Prof. Goodeve), have been tranferred to the new buildings, South Kensington, where they will open in the beginning of October.

Mr. Andrew Murray writes to the *Gardener's Chronicle* that he has, within the last few weeks, made some observations at the Ochil Hills, Kinross-shire, on *Pinguicula* and *Drosera*, with reference to the fly-digesting powers they are asserted to possess. He states that he found the leaves of *Pinguicula* close, quite independently of the fact of a fly being in them or not. "The leaves are found with their margins in all stages of curling over, some with no insect on them much more curled over than others with several." The secretion which Dr. Hooker states kills a captured insect he finds is glutinous, and he believes it does not fall on to the insect, but that death results from the secretion adhering to and closing up the spiracles by which the insect breathes. With regard to Dionæa, he suggests that it should be carefully noted (1) whether the secretion is never present until after an insect has been captured; (2) whether it is always present after one has.

Among the recent additions to the Manchester Aquarium is fine specimen of the Monk or Angel Fish, between five or six feet in length, and weighing at least one hundred pounds. With the exception of an example of very similar dimensions brought to the Brighton tanks about a year ago, but since dead, it is one of the largest yet recorded as taken on the British coasts. This specimen was captured at Colwyn Bay, near Conway, and is still in the most healthy and perfect condition. A number of young herring, of which fish the Manchester Aquarium now possesses many hundreds, were consigned last week by the curator, Mr. W. Saville-Kent, to the aquarium at the Crystal Palace; most of these arrived in safety, and are of especial interest as being the first of the species successfully introduced at that institution.

The additions to the Zoological Society's Gardens during the past week include a Chimpanzee (*Troglodytes niger*); a Bay Antelope (*Cephalophus dorsalis*), and three Royal Pythons (*Python regius*), from West Africa, presented by Mr. C. B. Mosse; a King Vulture (*Cyparchus papa*) from South America, presented by Mr. G. I. Brumschweiler; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Capt. Hallett; two Little Bitterns (*Ardetta minuta*), European, presented by Mr. A. A. van Bemmelen; an Alligator (*Alligator mississippiensis*) from Demerara, presented by Capt. Turner; a Yellow-fronted Amazon (*Chrysotis ochrocephala*) from Guiana, deposited.

MARITIME CONFERENCE

The conclusions come to by the recent Conference on Maritime Meteorology have been forwarded to us with the following letter:—

"Sir,—I have the honour to inform you that the Permanent Committee of the International Meteorological Congress at Vienna (1873), at whose suggestion the recent Conference for Maritime Meteorology was held in London, has resolved to forward the Resolutions adopted at that Conference for publication at once, thus anticipating the publication of the full Official Report of the Conference. The Permanent Committee will feel deeply obliged if you can find space for them.

"Robert H. Scott,
"Secretary to the Permanent Committee."

Resolved—"That there should be but one form of Meteorological Register for the Navies and Merchant Services, and that those who cannot fill the log should keep part of it."

Questions.	*Resolutions.*
I. - Observations—	
Columns 1 to 6.*	*Date and Position of the Observations.*
Is it your opinion that a fresh column should be added headed "Course and distance by the log in every watch of four hours?"	That an additional column should be given in the log for "Course and distance." That the course should be expressed in degrees, and not in points. That the question of hours, 4-hourly periods, as proposed by Captain Toynbee, should be, adopted.
Columns 7 and 8.—	*Currents.*
	That observations on the "direction and rate" of currents be transferred to the column for Remarks.
Column 9.—	*Magnetic Variation.*
Is it desirable to give an additional column for the "Direction of ship's head"?	That an additional column be given in the log for the direction of the ship's head, and the amount of heel to port or starboard. That the total compass-error and not variation only be given. That the Conference expresses its opinion that the lettering on the English compass should be adopted by all nations for meteorological purposes.
Columns 10 and 11.—	*Wind Direction and Force.*
Is it possible to employ an anemometer at sea, so as to give trustworthy results?	That a decided answer to this question cannot at present be given, but it is desirable that various anemometers should be tested by special ships, and that a special form of four extra columns should be prepared for the purpose of recording such observations.
Can the use of the Beaufort scale be made universal?	That the use of the Beaufort scale should be continued, with the addition of the amount of sail which Beaufort's ship would have carried had she been rigged with double topsails. Also that the direction and force of the wind should be recorded at the *time* of observation, and not estimated for a certain number of previous hours. Also, that they should be recorded every two hours.
Columns 12 and 13.—	*Barometer.*
To what degree of minuteness is it necessary to observe this instrument?	To one-hundredth of an inch at sea, or its equivalent in the metric scale.

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* The numbers of the columns refer to the Brussels Abstract log.

Columns 14 and 15.—*Thermometers, Dry Bulb and Wet Bulb.*

Should these observations be required from all ships?	That wet and dry bulb observations are desirable, and should be obtained whenever possible.

Column 16.—*Forms and Direction of Clouds.*

Is this column sufficient, or should any notice be taken of more than one stratum of clouds?	That the upper and lower clouds should be recorded in separate columns, and that the direction from which *upper* clouds come should be recorded when possible.

Column 17.—*Proportion of Sky Clear.*

Is it not advisable to substitute for this heading "Proportion of sky clouded"?	That it is preferable to give the proportion of sky clouded instead of the entry "proportion of sky clear," as recommended by the Brussels Conference.

Column 18.—*Hours of Rain, Fog, Snow, &c.*

Is it desirable to retain this heading, or to substitute for it and No. 23, a column headed "Weather by Beaufort Notation"?	That it is desirable to retain this heading, but that the use of Beaufort's Notation may be continued by those accustomed to it.

Column 19.—*State of the Sea.*

Should this be given according to a numerical scale?	That a numerical scale (0 – 9) be adopted, and that an extra column should be given to the observation. The direction of the sea swell, or the different swells, to be given in the original column.

Columns 20 to 22.—*Temperature of Sea Surface, Specific Gravity, Temperature at Depths.*

Is it desirable to retain these columns, or can the observations when taken be inserted in the column for "Remarks"?	That the first two columns should be retained. That sea temperatures at depths should not be required from all ships, and should be recorded in the "Remarks."

Column 23.—*Weather.*

	Vide the resolution on Col. 18.

Column 24.—*Remarks.*

	That the "Remarks" as asked for by the Brussels Conference should be adopted, with the exception of the observations of temperature with coloured bulbs at sea.

II.—INSTRUMENTS.

What patterns of instruments should be employed for any observations which may require them?	That the question of the precise pattern of instruments is not of very great importance, so long as they satisfy the tests applied at the several central Institutions and are compared with standard instruments; but it is recommended that they shall be of a pattern as easy as possible for reading.
Is there any reasonable possibility of introducing the metric and centigrade systems for general use at sea?	The recommendation respecting the use of the metric and centigrade systems as expressed at the Vienna Congress was approved, and it was recommended that a table of conversion should be entered in each log to enable Captains to compare barometers which have different scales.

III.—INSTRUCTIONS.

Is it possible to devise a general form of Instructions to ensure uniformity in regard of methods of observation and registration?	That the Instructions should be suited to the log now proposed by the Conference, but modified to meet the various requirements of different nations.

The Conference requested that Capt. Toynbee's proposed form of log should be lithographed and the English "Instructions" printed for circulation amongst its members.

IV.—OBSERVERS.

What control should be exercised over the Observers as to their instruments and registers?	That it is necessary that all instruments used should be compared with standard instruments, either at the central or the filial institutions (if such exist), before and after the voyage; and that the corrections and date, &c., of the comparison should be entered in the log.
Is it desirable that all instruments employed should be the property of the central establishment, and *lent* to the observers?	That it is desirable that the instruments should be the property of the central office. That it is necessary that a careful examination should be made into the quality of the observations recorded, and that the attention of the observers should be specially directed to any errors which may have been detected.

V.—CO-OPERATION OF THE ROYAL NAVY.

To what extent can ships of war assist in forwarding the ends of meteorological inquiry?	The Royal Navy can furnish more complete observations than are possible on board merchant ships, as, *e.g.*, Deep-sea soundings and temperatures. Observations in unfrequented parts of the sea. Special experiments. It is most desirable that the duty of observing should be intrusted to some responsible Officer. It is therefore resolved that the Authorities of the Navies shall be requested to continue to give such assistance to the prosecution of meteorological science as circumstances shall permit.

A Report was handed in which had been drawn up by a number of the members who were in the Naval Services of some of the countries represented, and it was decided that the following resolutions which it contained should be adopted in lieu of those given above:—

1. "It is very important that the organisation of meteorological inquiry as regards the Navies of all countries should be arranged in accordance with the principles and stipulations laid down by the Conference for Marine Meteorology generally; and it is further important that the results of all observations made on board ships of war in any country should be rendered accessible for discussion by the central station for maritime meteorology in that country without prejudice to any subsequent publication by the respective Naval Authorities."

2. "The Conference, while admitting that the introduction of measures calculated to improve the condition of meteorological inquiries in the Navy must be left to the Authorities of the respective Navies, is nevertheless of opinion that all care should be taken to secure uniformity as to mode of observation, and especially to provide for the comparison of all instruments used with the respective standard instruments of the Central Institutes."

3. "The Conference considers it to be its duty to request that those entrusted with the management of scientific affairs on board men of war will lend their strenuous support in securing from the Naval Authorities in each country such regulations as will place meteorological inquiry on board such ships in as favourable a position as may be deemed consistent with the execution of the ordinary duties of the Service, and will also induce the commanders to render to such inquiries all the assistance and furtherance in their power. The Conference, knowing that such regulations must be framed according to the requirements of each country, expresses, nevertheless, its opinion that, inasmuch as meteorological observations require considerable experience, they should be entrusted to experienced Officers on board suitable vessels."

4. "Although the Conference is of opinion that, as far as the general scope of meteorological inquiry goes, the same form of register should be supplied to merchant ships as to men of war, it declares it will be most desirable that, besides the regular observations, a more extended scale for scientific inquiry should be adopted on board ships of war, as in such cases there is a large number of suitable officers, as well as more means for carrying on the service. As examples of observations which are of importance for the development of Maritime Meteorology, over and above the regulations embodied in the scientific instructions given to Naval expeditions for the special purpose of the advancement of science, the following suggestions may be enumerated :—

(*a*) "Possibility of carrying out accurate observations on the velocity of the wind by anemometers at sea.

(*b*) "Possibility of employing rain-gauges satisfactorily at sea.

(*c*) "Observations with Regnault's and other hygrometers, and experiments on the best mode of observing wet and dry thermometers, and the best position to place them in on board ship.

(*d*) "Currents at the surface and at depths to be observed with great minuteness, with the special object of defining their limits.

(*e*) "The comparison of various instruments, among which are expressly mentioned that of aneroids with mercurial barometers. It is further deemed very desirable that frequent comparisons should be instituted between the instruments used at sea and meteorological stations on shore in various countries.

(*f*) "Deep-sea soundings and temperatures, with specimens of water.

(*g*) "The collecting of information on Ocean Meteorology at outlying stations.

(*h*) The furnishing of synchronous observations at oh. 43m. G. M. T., in accordance with the suggestion and request of the United States Signal Office."

VI.—DISCUSSION.

Can general suggestions be thrown out as to the most profitable mode of discussing the observations?	That it is desirable that every Institution should publish the observations and results in such a manner that every foreign institute can incorporate them with its own observations and results in the easiest way possible; that is, by preserving the number of observations, together with any means derived from them, for single square degrees. That it is further desirable that, whatever charts be published, the results for single square degrees should be published in a tabular form. That it seems desirable for the use of the sailor that each chart should have reference to only one element, or, at least, only to elements closely related to each other.

VII.—SUBJECTS OF INQUIRY.

To what extent can a division of labour, as regards subjects of inquiry, be carried out in a spirit of fairness to the collecting and discussing establishments respectively?	That the division of labour, as regards investigations, can only be carried out by mutual agreement between the several institutions; and each institution should announce to other institutions what investigations it proposes to undertake. It is very desirable that such divisions of labour should be effected.

VIII.—SAILING DIRECTIONS.

In how far are purely practical investigations, such as the preparation of sailing directions, admissible for a scientific institution?	That the sailor wants the result of experience alone, and he must receive assurance that his observations have been turned to use. When these results of experience have been given, the theorist may point out the reason why certain routes are the best.

It was resolved, that Capt. Toynbee's remarks on the programme should be printed in full, with extracts from the remarks of other gentlemen, should they contain important suggestions.

THE BRITISH ASSOCIATION

REPORTS

Report of the Committee on Luminous Meteors, by Mr. Glaisher.—The appearance of meteors noticed in published journals, and otherwise ascertained by the committee during the past year, include some striking examples of such remarkable exhibitions, discussed and investigated very ably by astronomers, as well as of others passing almost unobserved excepting by accidental gazers. A few such large meteors were doubly observed in England. Some have been visible in the day-time, while many other large and small fire-balls have been described to the committee, of which it is to be regretted that notices have hitherto only reached them from single observers. The months in which these phenomena have been most abundant were September, December, and January last, April, June, and again quite recently, the last few days of July and beginning of August of this year. The report contains descriptions of the brightest of these meteors, and an account of Prof. Galle's calculations and inquiries regarding the real cause of two large meteors which passed over Austria on the 12th and 19th of June last, with the probable path that he assigned to them. If a mass of burning sulphur found on the ground immediately after the disappearance of the latter meteor is not considered presumably meteoric, no occurrence of a fall of aerolites, as far as the committee is aware, has taken place during the past year.

The annual star-showers have been watched for with the usual attention of observers in correspondence with the committee; and the results of their combined observations are described, with accounts of some other occasional star-showers, at some length in the descriptive part of the report. Although little important information was thus added this year to our present well-known star-showers of January, April, and October, and the cometary meteor showers of November 14 and 27, connected with Tempel's and with Biela's comet, all of which, in spite of very favourable weather for their observations, were this year most remarkable by their non-appearance; yet the fluctuating intensities of these showers at their successive periodic dates are an important element to record; and in the case of the star-showers of August 10 and December 12 of the past year, the watch was at least attended with more positive success. Duplicate observations of meteors were obtained in them, and the general centre of divergence of each of these two meteor-currents was pretty exactly ascertained. Bright meteors were more frequent on each of these two nights than is at all usual in ordinary exhibitions of those showers. It will be found among these observations that the return of Biela's meteor-shower on the 27th of November last disappointed expectation, and the small extent and rapid departure of that meteor-cloud from the earth's neighbourhood is clearly shown by its visibility as a star-shower only for a single year.

The duplicate observations described in former reports have been reduced at the request of the committee by Mr. T. H. Waller, whose report of these calculations is added, and whose conclusions of their real heights and velocities are without doubt very accurate and complete.

The publication of Capt. Tupman's observations of shooting stars in the Mediterranean during the years 1869-71, with the list of radiant points obtained from them and shown on a pair of charts accompanying them by Capt. Tupman, is now brought to a close, and the catalogue and charts have been sent to astronomers and correspondents of the committee in England and abroad, and in America, and discussions of these in foreign scientific journals have appeared, showing the important light in which the appearance of this valuable new meteor catalogue has been regarded. Its principal part, the comparative catalogue of his meteor-showers with those of other observers, and the charts on which they are projected, are presented in this report, with Dr. Schmidt's similar catalogue (the remaining two principal meteor-shower lists, of which no account has yet appeared in these reports), thus placing before readers of recent volumes of these reports all the material contributions to this branch of meteoric astronomy that have yet been made.

They are summed up in a very concise catalogue at the end of this report by Mr. Greg, who has selected, to corroborate such observations already published in his former lists, the greater part of Dr. Schmidt's and Capt. Tupman's observations, and has included them with his own former collection, thus forming a very extended catalogue founded on all the similar work of his contemporaries and predecessors, and omitting but few genuine meteoric showers, chiefly in the southern hemisphere, which have only been observed by Dr. Neumayer in Australia.

Following the method of Dr. Weiss, viz. to calculate the radiant points of those comets of early and recent times whose orbits are believed to pass near the earth, a list of such comets for both the northern and southern hemispheres is annexed to Mr. Greg's catalogue, and the cases where they corroborate each other are pointed out. Many important and well-known comets are found to have meteor-showers as their present representatives, as would, perhaps, be still more apparent if more reliable orbits of comets could be used; but the coincidences are, however, numerous enough and sufficiently exact to render desirable the further cultivation of cometary astronomy by the help of star-shower observations.

Report on Isomeric Cresols, by Dr. Armstrong.—Little has been done by the committee during the past year. *Para* and *ortho* cresols have been obtained from ordinary cresylic acid, but it has not been with certainty determined whether the *meta* cresol is likewise present, or whether these are the sole constituents of this substance.

Report of the Committee for the Utilisation of Sewage, by Prof. Corfield.—The committee has been unable, from want of funds, to carry on the quantitative experiments as they would have wished. Of the total nitrogen supplied to the farms during the year March 25, 1873, to March 24, 1874, 37·7 per cent. was recovered in the crops, during the preceding year 41·7 per cent. was recovered, while during the first year of the experiments the nitrogen recovered amounted to 26 per cent. The committee will be enabled, through the liberality of a gentleman, to carry on their investigations during another year.

SECTIONAL PROCEEDINGS

SECTION A—MATHEMATICS

On the Construction of a perfectly Achromatic Telescope, by Prof. G. G. Stokes.

At the meeting of the Association in Edinburgh, in 1871, it was stated that it was in contemplation actually to construct a telescope by means of discs of glass prepared by the late Mr. Vernon Harcourt, which should be achromatic as to secondary as well as to primary dispersion. This intention was subsequently carried out; and the telescope, which was constructed by Mr. Howard Grubb, was now exhibited to the Section. The original intention was to construct the objective of a phosphatic glass containing a suitable percentage of titanic acid, achromatised by a glass of terborate of lead. The percentage of titanic acid was so chosen that there should be no irrationality of dispersion between the titanic glass and the terborate. As the curvature of the convex lens would be rather severe if the whole convex power were thrown into a single lens, it was intended to use two lenses of this glass, one in front and one behind, with the concave terborate of lead placed between them. It was found that provided not more than about one-third of the convex power were thrown behind, the adjacent surfaces might be made to fit, consistently with the condition of destroying the spherical as well as the chromatic aberration. This would render it possible to cement the glasses, and thereby protect the terborate, which was rather liable to tarnish. At the time of Mr. Harcourt's death two discs of the titanic glass had been prepared, which it was hoped would be good enough for employment, as also two discs of terborate. These were placed in Mr. Grubb's hands. On polishing, one of the titanic discs was found to be too badly striated to be employed; the other was pretty fair. As it would have required a rather severe curvature of the first surface and an unusual convexity of the last to throw the whole convex power into the first lens, using a mere shell of crown glass behind to protect the terborate, Prof. Stokes thought it more prudent to throw about one-sixth of the whole convex power into the third or crown-glass lens, though at the sacrifice of an *absolute* destruction of secondary dispersion, which by this change from the original design might be expected to be just barely perceptible. Of the terborate discs, the least striated happened to be *slightly* muddy from some accident in the preparation; but as this signified less than the striæ, Mr. Grubb deemed it better to employ this disc. The telescope exhibited to the meeting was of about 2¼ in. aperture, and 28 in. focal length, and was provided with an objective of the ordinary kind, by which the other could be replaced, for contrasting the performance. When the telescope was turned on to a chimney seen against the sky and half the object-glass covered, in the case of the ordinary objective, vivid green and purple were seen about the two edges, whereas with the Harcourt objective there was barely any perceptible colour. It was not, of course, to be expected that the performance of the telescope should be good, on account of the difficulty of preparing glass free from striæ, but it proved to be quite sufficient to show the possibility of destroying the secondary colour, which was the object of the construction.

On Cyclone and Rainfall Periodicity in connection with the Sunspot Periodicity, by Charles Meldrum.

The catalogue of cyclones experienced in the Indian Ocean, from 1847 to 1873, submitted last year, indicated that during this period the number of cyclones in the space between the equator and 34° S. lat. and the meridians of 40° E. and 110° E. are much greater in the years of maximum than in the years of minimum sunspot frequency.

It will now, and in subsequent reports, be shown that not only the number of cyclones, but their duration, extent, and energy, were also much greater in the former than in the latter years, and that there is a strong probability that this cyclonic fluctuation has been coincident with a similar fluctuation of the rainfall over the globe generally.

The present communication is confined to the twelve years 1856-67, comprising a complete sunspot cycle.

With regard to the cyclones of the Indian Ocean, the investigation is based upon the extensive collection of observations made by the Meteorological Society of Mauritius on the assumption that the observations are so numerous that no cyclone of any considerable extent or violence can have escaped detection.

A chart has been prepared for noon on each day of the period during which a cyclone lasted. The chart shows the positions of the vessels, the directions and force of the wind, the state of the weather and sea, &c. In this way the position of the centre of the cyclone is ascertained for each day; then, by examining the several charts, the duration, extent, &c. of the cyclone are determined.

The number of cyclones thus examined for the twelve years is 113, and their tracks have been laid down on six charts.

The total cyclonic area in 1860 and 1861 was about twelve times greater than in 1856 and 1857, and nearly eight times greater than in 1867; in short, all the factors were greater in the years of maximum sunspot frequency. It is evident from the table that the cyclonic area increased rapidly from 1858 to 1860, and diminished slowly from 1861 to 1866. The registers for the years 1856, 1857, 1866, and 1867 have been examined with special care in order that nothing might be omitted; and, to give the utmost possible weight to those years, every instance of even an ordinary gale has been taken into account. In 1856 there was no great hurricane at all, and the same may be said of 1857, 1866, and 1867. From the chart for 1866 it will be seen that in April of that year there was a number of small cyclones. The south-east trade-winds and north-west monsoon were in collision for a considerable time, and several cyclonic eddies of short duration were formed.

If we could obtain good values of the mass of air in motion and the velocity of the wind, it would probably be found that the ratios of cyclonic energy were greater than those of cyclonic area, for in the maxima years the cyclones were much more violent than in the minima years. Assuming the mass to be nearly proportional to the area, and the velocity of the wind in a strong gale to be 55 miles, in a whole gale 70 miles, and in a hurricane 85 miles an hour, the amount of cyclonic energy in 1860 was about eighteen times greater than in 1856, the squares of the velocities being as three to five.

Although the results are necessarily rough approximations, yet the fact that the number and violence of the cyclones of years of maximum sunspot were far greater than in the years of minimum sunspot is beyond all doubt.

When a great hurricane takes place in the Indian Ocean, the disabled ships are obliged to put into the nearest port, and the newspapers in their shipping intelligence announce the arrival of the vessels, the dates and localities of the bad weather, and the amount of damage sustained. For upwards of twenty years the *Commercial Gazette* of Port Louis has published all arrivals of vessels and all maritime events which have been reported by them. Considering, then, the geographical position of Mauritius, a cyclone periodicity, if one exists, should be traceable in the shipping intelligence. Now, from Table II., which gives the published reports for 1856, 1860, and 1867, it will be seen that the number of storms and the damage sustained in 1856 and 1867 were insignificant compared with the long list of hurricanes and disasters in 1860.

Table III. gives as complete a list of hurricanes and storms experienced in Mauritius as I have hitherto been enabled to prepare. The list comprises only such storms as from the violence of the wind committed considerable damage.

Table IV., which contains a list of Bourbon (Réunion) hurricanes and gales from 1733 to 1754, shows also the number of hurricanes that occurred in the maximum and minimum sunspot years.

For the two islands the number of cyclones in the maxima years was thirty-six, and for the minima years nineteen. This result is favourable.

It would appear also from M. Poey's researches, and from investigations made at Mauritius in 1872, that the cyclones of the West Indies are upon the whole subject to the same periodicity. The rainfall for the twelve years under discussion is given in Tables V. to IX. It thence appears from the rainfall at sixty-seven stations that the maximum fall was in the years 1859 to 1862, and the minimum in the years 1857, 1858, and 1864. We thus find a certain degree of correspondence between the cyclone and rainfall fluctuations; and it is possible that if we had returns from America the correspondence would be much greater; for it would appear from researches by Mr. G. M. Dawson, that the level of the American great lakes was considerably less in 1867–68 than in 1859–61. (The year 1867 has been almost the only exception to the rule in Europe since the commencement of the century, and as most of the stations are in that part of the world the results for 1856 and 1857 are not so favourable as for previous cycles).

A large number of additional rainfall returns has been received from Europe and other parts of the world, and the results, which will be communicated in another report, afford fresh evidence of a rainfall periodicity.

(The paper was accompanied by several elaborate tables).

SECTION B—CHEMICAL SCIENCE

On some Opium Derivatives, by Dr. C. R. A. Wright.—The action of free chlorine on codeine is to produce higher polymerides, especially tricodeine, from which again, by the action of hydrochloric acid, apocodeine is formed. This apocodeine may be looked on as three molecules of codeine *minus* six molecules of water. Narceine is feebly basic, but it has a strong attraction for hydrochloric acid, giving rise to the crystallisable hydrochloride $C_{23}H_{29}NO_9 + HCl$. If the salt is dissolved in boiling water, crystals are obtained containing six molecules of $C_{23}H_{29}NO_9$ plus one molecule of HCl. Basic chlorides, probably not definite compounds, have also been obtained. With excess of hydrochloric acid at 100° the elements of water are removed from narceine, and we get $C_{23}H_{27}NO_8$. The hydrochloride of this base is non-crystallisable. By the action of glacial acetic acid on codeine there is produced diacetyl codeine, $C_{36}H_{40}2(C_2H_3O)N_2O_6$. Acetic acid acts in a similar way on morphine, a considerable quantity of triacetyl morphine being also produced. Acetic anhydride gives rise to the formation of an isomeric diacetyl morphine. We have, therefore,—

α diacetyl morphine	. . .	crystallisable
and β ,, ,,	. . . .	non-crystallisable.

Butyric and benzoic acids give analogous compounds; so also do acetic acid and strychnine. The following general formulæ for the morphine and codeine salts are given:—

$$M + nHX - nH_2O,$$
$$C + nHX - nH_2O,$$

when HX = a monobasic acid.

On a Phenomenon noticed on boring a Well, by Dr. Andrews.—The author described a remarkable jet of almost pure marsh-gas, obtained on boring a well near Belfast. The borings first descended through about 33 ft. of silt, and then reached a gravelly deposit 7 ft. in thickness, interspersed with organic *débris*. It was from this deposit that the marsh-gas was evolved.

Reaction of Hydrogen, Peroxide, &c., by Mr. Fairley.—The author believes that he has succeeded in preparing hypochlorous acid according to the equation $H_2O_2 + Cl_2 = 2HClO$. By the action of hydrogen peroxide on bleaching powder, and on other hypochlorites, oxygen is evolved; thus, with potassium hypochlorite, $KClO + H_2O_2 = KCl + H_2O + O_2$. Chloric acid has no action on hydrogen peroxide; neither has sulphuretted hydrogen in the absence of air. By the action of ozone on hypochlorous acid there seems to be produced perchloric acid.

On the General Equations of Chemical Decomposition, by Prof. Clifford, F.R.S.—This paper was also read before Section A. The author thinks that chemical equations may be brought under a general formula. Thus, $H_2 + Cl_2 = 2HCl$. If we assume that there is a structure common to the hydrogen and the chlorine atoms, also a structure confined to the hydrogen and likewise a structure confined to the chlorine atoms, we may represent this equation thus: $XYY + XZZ = 2XYZ$, when X represents the common structure and Y and Z the structures which are confined to hydrogen and chlorine respectively. So $2H_2 + O_2 = 2H_2O$ may be represented thus: $2XY + XXZZ = 2XXYZ$. These equations involve no hypotheses, because the fundamental facts of the molecular theory are now firmly established. Reasoning from these and similar equations, the author deduces the result that the ordinary equations of chemistry, such as those just stated, are expressive of facts, and that the hydrogen molecule really consists of two equal atoms.

On the presence of Cyanogen in Commercial Bromine, and a means of detecting it, by Dr. T. L. Phipson.—The author states that commercial bromine often contains cyanogen; by adding an equal weight of iron filings and four to five times its weight of water to the bromine, stirring, filtering, and allowing the filtrate to remain for twenty-four hours in a closed bottle, a precipitate of *Prussian blue* is thrown down if cyanogen is present.

On a Sesqui-sulphide of Iron, by Dr. Phipson.—The author describes a greenish black salt having the composition Fe_2S_3. This salt is produced by precipitating a ferric salt by means of ammonium sulphide in the presence of a free chlorite or hypochlorite. The salt is soluble in hot water, also in ammonia, giving an emerald green liquid.

On the Chlor-Bromides and Brom-Iodides of the Olefines, by Prof. Maxwell Simpson, F.R.S.—The author described various substances obtained by acting on ethylene, &c., with iodine chloride, with bromine chloride, with bromine iodide, &c. In the case of ethylene the substance C_2H_4BrI, C_2H_4ClI, and C_2H_4ClBr, were described. These bodies may also be obtained by agitating the chloride bromide or iodide of ethylene with a solution of iodine or bromine chloride: thus, $C_2H_4Br_2 + BrI = C_2H_4BrI + Br_2$. The reaction $C_2H_4Cy_2 + BrCy = C_2H_4CyBr + Cy_2$ would not take place; indeed, the author was totally unable to prepare the brom- or iodide cyanide corresponding to the salts just mentioned.

On an Aspirator, by Dr. Andrews, F.R.S., and *On another form of Aspirator*, by Prof. Delffs, could not well be understood without drawings.

SECTION C—GEOLOGY

The Geological Structure of the Tyrone Coal-field.—Mr. Hardman, after describing the position of these beds, remarked that the carboniferous rocks of this district appear to resemble somewhat those of the northern counties of England. The coal-bearing beds are true coal measures. The underlying limestone is split up by numerous sedimentary beds, and, on the whole, agrees with the Ballycastle coal-field, which beds Prof. Hull assigns to the same horizon with those of the Scotch coal measures. The author referred in detail to the thickness and position of the beds. With reference to the Dungannon coal-field, which extends from near Dungannon to beyond Coalisland, he remarked that though small in area it was rich in coal seams, possessing twenty-four coal-beds, of which at least thirteen were workable. They are highly bituminous, and two of the beds contain valuable seams of cannel coal. The chemical analyses show that these coals are valuable, possessing from 37·5 to 47 per cent. of volatile matter for gas manufacture. In the upper measures we have valuable deposits of fire-clay, which are extensively used for the manufacture of bricks and tiles. The ironstones are not sufficiently abundant to be worked, yet they yield as much as 21·7 to 35·5 per cent. of metallic iron. There must be from 30,000,000 to 40,000,000 tons of coal yet untouched. If we count the smaller beds we shall have at least 9,000,000 more. The coal-field is bounded on the north-west by a large fault, which brings down the coal measures on the south against the calp and lower limestone. It must have a downward throw of 2,000 feet. Northwards, the limestone is covered by trias, without any intervening coal measures, for three-and-a-half miles, when a small trough of the middle coal measures, with four of the upper Coalisland beds, rise up. This field is but two-and-a-half miles long, and a quarter wide, and yet it must contain the whole series of the middle and lower coal measures, the millstone grit and Yoredale beds. Here, the author calculates, there are 800,000 tons of coal. The author proceeded to explain when and how the two coal-fields became isolated from each other; and why, in the immediate vicinity of these coal measures, the Permian rocks are, found reposing directly on the limestone. At the close of the carboniferous period the rocks were forced into flexures, ranging east and west, owing to forces acting from the northwards, as Prof. Hull shows acted in England. Denudation following, we had a set of plains, or edges of limestone, and troughs of coal measures, all of which were overlapped by the Permian and Trias. On subsequent denudation and post-triassic faults occurring, some portions of the coal measures would be laid bare or saved beneath the newer formations. As the whole district is cut up by faults, and the rock exposures few, the evidences of these flexures are obscure.

SECTION D—BIOLOGY

DEPARTMENT OF ZOOLOGY AND BOTANY

Dr. Williams read a paper *On Specimens of Alga from Jersey*. The paper referred to the large number of species of marine algæ to be found at Jersey, and to the favourable position of the island for their development. Dr. Williams produced a splendid collection of algæ preserved by a lady residing in Dublin.

Prof. Lawson read a paper *On certain peculiarities in the Indian Ampelideæ*. He remarked that many of the species were climbers, with their branches interlacing in the tops of the highest trees. In the stems of all were to be found numerous very large ducts, and these ducts were filled with intra-cellular vesicles, in which, at a certain time of year, abundance of starch was developed. He also remarked that in the fruit most important differences might be found, but that these afforded no means by which to divide the genus into natural sections. With respect to the inflorescence, he said there was great variety of form. Two species only reached the eastern coast of Africa, most being confined to India, though some few were common throughout the Malayan Archipelago.

On the Growth of Tree-ferns, by D. Moore.—The general conclusions arrived at in this paper were (1) Some of the kinds of tree-ferns grow with greater rapidity and form their stems in a much shorter period than is generally supposed to be the case; (2) After they attain a certain height the acrogenous buds are formed much closer together, one above the other, than they are lower down on the stem; hence their elongation is much slower; (3) Some of the sorts which at first form short rhizomatous stems before they take an upright position require a considerable number of years to perfect the early parts, but after the stem has been formed and an upright position taken, the growth is much quicker and the elongation advances rather rapidly compared with it, while the stem remains in a rhizomatous state.

Mosses of the North of Ireland, by S. A. Stewart.—Turner, in 1804, enumerated as Irish 230 species of mosses; Dr. Taylor, in 1836, mentions about the same number; and Dr. D. Moore, in 1872, gives a list of 385 Irish species, to which the author of the present paper adds four others, viz., 389, or more than two-thirds of the British mosses. Thus, relatively to the British Flora, Ireland has quite as large a proportion of mosses as she has of flowering plants, proving that Irish muscology has not been neglected. No separate lists of the mosses occurring in the northern counties have been published; but after consulting the records of Dr. Taylor in the "Flora Hibernica," and the valuable list of Irish mosses by Dr. Moore, also some detached papers on the subject, the author ascertains that the number of species occurring in the district amounts to 195, or more than one-half of the Irish mosses. The district is defined to consist of the counties of Down and Antrim, with a small portion of Co. Derry, bordering on Antrim. The list includes a large number of rare mosses. The following have not been previously recorded as Irish, viz.:—*Fissidens incurvis* Schw. var. *Lylei*, found only on a greensand rock on the Black Mountain, near Belfast; *Tayloria serrata*, in small quantity, near the summit of Benbradagh Mountain, Co. Derry; *Mnium subglobosum*, in wet peat bog on Cave Hill, near Belfast, and in a similar habitat on Carrickfergus Common; *Seligeria calcarea*, on Black Mountain, near Belfast, appearing like black specks on small lumps of chalk in the grass. Mr. C. P. Hobkirk, of Huddersfield, has been kind enough to identify the specimens of the above-named mosses.

Prof. Dickson exhibited specimens of an abnormal form of the ox-eye daisy (*Chrysanthemum leucanthemum*), in which the outer florets of the ray (normally ligulate and female) exhibit an irregularly tubular corolla, not very unlike that in the neuter florets in certain Centaureas. Structurally these abnormal florets are hermaphrodite, but appear always to be functionally neuter or sterile.

Mr. Bentham remarked that similarly abnormal tubular florets, structurally hermaphrodite, and functionally neuter, occur in certain varieties of *Chrysanthemum indicum* and *Dahlia*.

Mr. G. Bentham, F.R.S. read a report *On the recent progress and present state of Systematic Botany*, commencing with a summary sketch of the state of science in 1830, when the natural method of Jussieu was beginning to supersede the sexual system of Linnæus; of its progress from that year to 1859, when the study of the general affinities of plants had entirely superseded the classing them according to single organs; and of the great advance effected since 1859, owing to the explanation of affinities given by the adoption of the doctrine of evolution. After some notes on the language to be preferred, systematic works were then considered under the six several heads of *Ordines plantarum*, *Genera plantarum*, *Species plantarum*, Monographs, Floras, and miscellaneous descriptions. Under each head the particulars required were specified, the principal recent works glanced over, with a short mention of the chief desiderata now recommended to the attention of systematic botanists.

Prof. Thiselton Dyer referred to the paper as evidencing the labour necessary to acquire a proficiency in the knowledge of botany. Some people thought botanical study was a kind of pastime, but the paper just read proved the contrary.

Sir John Lubbock believed that *mutatis mutandis* a great deal of what Mr. Bentham said with regard to systematic botany would apply equally to zoology.

Prof. Dickson gave the results of his investigations on the embryogeny of *Tropæolum peregrinum* and *Tropæolum speciosum*. In these species the principal peculiarity consists in the constant penetration of the carpellary tissue by the extra-seminal root-process. In *Tropæolum majus* the extra-seminal root-process developed from the outer side of the base of the suspensor. After perforating the seed-coat it becomes elongated, and finishes its course in the cavity of the seed-vessel. In rare cases, however, this process has been found to penetrate by its very extremity the carpellary tissue. In *Tropæolum peregrinum* the extra-seminal process penetrates the carpel after having run in the cavity of the seed-vessel half-way. In *Tropæolum speciosum* this process dips into the carpel immediately after emerging from the seed. Dr. Dickson remarked that some would be disposed to look upon the abnormality in *Tropæolum majus* and the normal form in *Tropæolum peregrinum* as forms representing what might be viewed as stages in the evolution of such a species as *Tropæolum speciosum* from some form analogous to *Tropæolum majus*. In regard to this, Dr. Dickson adversely criticised the Darwinian hypothesis, as, in his opinion, inapplicable to the case under consideration.

Mr. A. W. Bennett read a paper *On the form of pollen-grains in reference to the fertilisation of flowers*. He stated that although not unfrequently a common form of pollen-grain runs through a whole group of plants, yet more often the form is found to be adapted to the requirements of the species, and varies even within a small circle of affinity. In those plants which are fertilised by the agency of insects, there are three general modes in which the form of the grain is adapted for the purpose. We have, firstly—and this is by far the most common form—an elliptical grain, with three or more longitudinal furrows, as in *Ranunculus ficaria*, *Aucuba japonica*, and *Bryonia dioica*; secondly, spherical or elliptical, and covered with spines, as in many Compositæ, Malvaceæ, and Cucurbitaceæ; and, thirdly, where they are attached together by threads or a viscid excretion, as in *Richardia Æthiopica*. In those plants, on the contrary, which are fertilised by the agency of the wind, as most grasses, the hazel, and *Populus balsamifera*, the pollen is almost perfectly spherical and unfurnished with any furrows, and is generally, moreover, very light and dry. The genus Viola supplies two very markedly different forms, in one of which, the section to which *V. canina* and *V. odorata* belong, the grains have the ordinary elliptical three-furrowed form, and where every point of the structure of the style and stigma is favourable to fertilisation by bees; the other, the section to which *V. tricolor* belongs, where they are very much larger and either pentagonal or hexagonal, and the style and stigma are adapted for fertilisation by Thrips. In all Crucifers hitherto known the pollen has the most common form. *Pringlea antiscorbutica*, the "Kerguelen's Land cabbage," has been shown by Dr. Hooker to be wind-fertilised, from the following considerations: the absence of petals, the absence of honey-glands, the exserted style, and the stigma being covered with long papillæ. The form of the pollen supports the same view, being very small and perfectly spherical, extremely different therefore from every other plant of the order. In the cowslip and primrose there is a uniform difference in size between the pollen belonging to the two dimorphic forms, that of the short-styled being always considerably larger than that of the long-styled form. An interesting discussion followed, in which Dr. Hooker, Prof. Dickson, Sir J. Lubbock, Prof. Balfour, and Mr. W. E. Hart took part.

SCIENTIFIC SERIALS

Memorie della Societa degli Spettroscopisti Italiani, June.—This number contains a very interesting account of the theories of the cause of formation of comets' tails, by Schiaparelli. The author seems to have no doubt that a repulsive force is in action, and that the only two acceptable theories are that the force is due to electricity or the repulsive power of the sun's heat.—Tacchini contributes a note on the polarisation of the zodiacal light, in which he corroborates Wright's observations of polarisation, and the presence of reflected sunlight. He also adds position observations of Coggia's comet in June.—Prof. Lorenzoni contributes a paper On some theoretical researches for a manner of rendering the whole of the solar chromosphere visible at once.

Bulletin de l'Académie Royale de Belgique, tome 37, No. 6.—This number contains an article by M. P. I. Van Beneden, On the whales of New Zealand. He refers to the fact that Dr. Gray of the British Museum has recognised three species in the New Zealand district, *Neobalæna marginata*, *Caperea antipodium*, and *Macleayius australiensis*, and urges that among the right whales there should be but one genus, *Balæna*. Those genera were established on imperfect data, and now that we have more material, several supposed diagnostics are found not to exist, and those that are established are of no great importance. As regards the skeleton at the Museum at Paris, studied by Prof. Lilljeborg, being without the ear-bone, that had been removed to be figured, and had not at the time been replaced. It is reported, however, as safe. Dr. Gray, believing that Van Beneden's drawing of the ear-bone was from some other source, erected it into a new genus.—MM. Cornet and Briart draw attention to some little known beds of phosphate of lime in the cretaceous beds of Hainault, and urge their being worked commercially.—M. Gluge gives a short note on tonic muscular contraction being converted into rhythmic contraction. His observations were on the sphincter ani muscles of rabbits, and he refers to similar experiments by M. Goltz on a dog. He believes that such experiments may lead to the explanation of the rhythmic contraction of the heart.

SOCIETIES AND ACADEMIES

Paris

Academy of Sciences, Sept. 14.—M. Bertrand in the chair.—The following papers were read:—Science before grammar, by M. E. Chevreul. A considerable portion of the paper (which is but an abstract of a more lengthy memoir) is devoted to a discussion of the word "*fact.*" The author also draws a parallel between psychic and chemical analysis, the former separating simple ideas perceptible by the mind, and the latter ponderable simple substances perceptible by the senses. The difference between the moral and political sciences and the sciences of the domain of natural philosophy is pointed out, and in an appendix the author states his reasons for dissenting from scepticism and materialism.—On a particular toxic action exercised at a distance by *Colchicum autumnale* at the time of flowering; extract from a letter from M. Is. Pierre to M. Dumas. The hand, when held near the anthers of the flowers without coming into actual contact with them, changes in a few seconds to a livid greenish-yellow colour. The natural colour returns about ten seconds after the removal of the hand. The author believes that this remarkable action is chiefly exerted during or near the period of fertilisation, and proposes to examine further the nature of the substance emitted.—New conditions for the production of the silent electrical discharge; its influence on chemical reactions; by M. A. Boillot. The author concludes, from his experiments, that the space traversed by the silent discharge can be considerably augmented without a diminution in the chemical effects produced.—On some tungsten minerals from Meymac (Corrèze), fourth note, by M. Ad. Carnot. The minerals now described are wolfram (containing $FeWO_4$ and $MnWO_4$) calcareous scheelite (containing $CaWO_4$), and hydrated tunstic acid, to which the author assigns the formula $2WO_3, 5HO$, or $WO_3, 2HO$ (old notation).—On the supposed migration of winged *Phylloxera* to *Quercus coccifera*, by M. Balbiani. The author states his belief that the species seen by M. Lichtenstein on this tree is not identical with *Phylloxera vastatrix*. The following species of *Phylloxera* are recognised in addition to *vastatrix*:—*P. quercus*, especially inhabiting *Quercus pedunculata*, and *P. coccina*, inhabiting *Q. robur*. The species found by M. Lichtenstein on *Q. coccifera* it is proposed to name *P. lichtensteinii*.—Experiments on the employment of alkaline sulpho-carbonates for the destruction of *Phylloxera*; a letter from M. Mouillefer to M. Dumas.—On new points attacked by *Phylloxera* in Beaujolais; a letter from M. Rommier.—On the actual state of the invasion of *Phylloxera* in the Charente provinces; extract from a letter from M. Maurice Girard.—Employment of the water used in purifying gas for the destruction of *Phylloxera*; a letter from M. G. Beaume.—Note on the action exercised by the soil of vine fields on sulphuretted gases, and memoir On the propagation of *Phylloxera*, by M. Cauvy.—Other communications were received on the same subject from various authors, and M. Dumas gave a *résumé* of M. Balbiani's observations, and stated that in future the sending of living specimens of the insect to Paris would be interdicted.—The Minister of Foreign Affairs forwarded to the Academy a communication from the French Consul at Messina, relating to the opening of new vents of eruption in Etna, and on some earthquakes felt at Messina.—On a transformation of the equations of celestial mechanics, by M. Allégret.—On the causes which modify the setting of plaster, new cements with plaster and lime bases, by M. Ed. Landrin.—Action of heat on phenylxylene, by M. P. Barbier. The products are anthracene, benzene, and xylene, produced thus—

$$2C_{14}H_{14} = C_{14}H_{10} + C_6H_6 + C_8H_{10} + H_2.$$

—On a case of decomposition of chloral hydrate, by M. Tauret. By the slow oxidation of this substance, carbonic oxide is liberated. The author thinks this furnishes a new explanation of the action of chloral upon the system, and accounts for the accidents occasionally resulting from its use.—On the development of red vapours during the boiling of saccharine juices in manufacture, by M. E. J. Maumené. The author attributes these to the action of nitrates. On the *rôle* played by gas in the coagulation of the blood, by MM. E. Matthieu and V. Urbain.—Synthesis of purpurine, by M. F. de Lalande. This was effected by the action of oxidising agents on pure alizarine.—During the meeting, a communication was read from his Majesty the Emperor of Brazil, offering his thanks to the Academy for adding a young Brazilian astronomer to one of the Transit of Venus expeditions.

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Our occupations are very engrossing, and they can be pursued with success only by the intensest stress and attention, and we are obliged even to limit ourselves to particular fractions and particular portions of our own study if we are to make any advance therein ; and unless we have the good fortune to be trained in early youth to take a broad and general view of the interests of human nature, unless our tastes are disciplined and refined, and unless we are led to see that we are citizens and men before anything else, I say it will go very hard indeed with men of science in future generations, and they will run the risk of becoming scientific pedants when they should be men, philosophers, and citizens. Still less, if possible, can I have anything to say respecting the Faculty of Law, but as regards that of Science, by which, of course, is understood physical science, I can only express my unmeasured satisfaction at the complete—I may almost say magnificent—arrangements provided for the teaching of this subject in this institution. The laboratory of my friend the Professor of Chemistry has, I take it, few parallels ; and if the laboratory of my friend the Professor of Physics is not so complete, I am sure it is far better than nine-tenths of such laboratories, and I am certain that those benefactions at which I was looking just now will, before long, enable him to put his establishment on the same footing as to completeness and magnificence as that of his colleague of Chemistry. I understand—indeed I know very well, knowing how much my distinguished friend, Prof. Roscoe, has been in this institution—that he had, I believe, the advantage of being on the spot when the building went on, and although I am sure he is the last man to take any more than his own share, somehow he has got a good deal. But now I come to that which is my proper subject to-day, and that is our Medical School. I have not seen in the course of my experience—I say it deliberately—I have not met with any more efficiently organised institution than you have within the four walls of that Medical School. I have some acquaintance with such institutions, and their interests, and I undertake to say that you will not find better constructed appliances for the teaching of those branches of science which relate to medicine than you will find in that school. Everything has been very carefully considered, and everything has been done which the idea of convenience could suggest, or which efficiency requires to have carried out. Addressing myself now rather to the lay portion of my audience, it may astonish many and puzzle them somewhat to know why so elaborate an apparatus is needed for the teaching of medicine, and why men require to spend so long a period of arduous study in that most important of pursuits. I believe this surprise arises from the prevalence in the general mind of the notion which was once exceedingly common in the philosophical mind, that the human body in general is dependent upon forces and powers which are altogether different from those we find working in other kinds of matter. It is not 200 years since the notion existed that the vital processes of the body were subject to some demon, who kept the body straight, I suppose when in good temper, and let it go wrong when out of sorts ; and when it was gravely supposed that there was a broad gulf between the phenomena of inorganic nature and those of life. Now let me say this, that the whole of our modern scientific study of medicine depends upon precisely the contrary assumption —upon the assumption that the living body is a mechanism infinitely more refined, and infinitely more difficult to understand, than our coarse human machinery, but still a mechanism governed by rules and laws which can be discovered and which can be applied and reasoned from, in order to understand its processes. Modern medicine, in fact, is a kind of engineering. It is the attempt to understand the machinery of the body for the purpose of being able to put it right when it goes wrong. I have seen in your great factories in Manchester some of those astonishingly complicated pieces of machinery which seem almost endowed with life, by which the products which make Manchester so famous are produced. Let me put before you the case of the possessor of one of those machines, who, finding that it has gone wrong and that it will not work properly, finds himself, as Sir Robert Peel would have said, with three courses open to him—either that he might sit down and hope that it would get better, and perhaps even offer up his prayers that it might get better ; or who should send to the nearest blacksmith and tell him to bring his hammer and bottle of oil, and tap here, or oil there, in the chance of setting the machine right ; or should, thirdly, send for some skilled and experienced mechanic who from long study and familiarity with it would be able to judge by the mode of action where it was wrong, and be able to put his finger on the part which was broken or injured, and thus be able to set it right. Now, the human body is a machinery which, in complexity, stands to the spinning jenny in the same relation as the spinning jenny stands to a child's windmill. But it stands by the same laws, and those who have to deal with it must be guided by the same reasoning. Sickness is the going wrong of the machinery. Death is the destruction of part of the machinery, and the only way in which that machinery can be set right, if it goes wrong, is not by sitting down and hoping for it, and it is not by sending for the first blacksmith who will administer his purge here and his bleeding there, and who is what we call a 'quack.' I mean a person who is really ignorant of that with which he is dealing, and who yet, nevertheless, presumes to meddle with it. That is the essence of quackery. Or, thirdly, we must send our skilled engineer, who, by the help of what he calls symptoms, finds out what wheel is out of place, what cog is broken, and by his previous knowledge of therapeutics knows in what way it is possible to get this erring wheel or broken pinion into its place again. And it is in order that we may have such skilled engineers to the body that all this great apparatus which you see erected here, and all this long period of study is carried out. I do not know anything which strikes me more forcibly than the progress which this kind of knowledge has made within the last thirty or forty years. . . . I happened to take up to-day the syllabus of your sessional work here, and I turn, not unnaturally, to the class of Practical Physiology and Histology, and on looking over the various doings of this course of instruction, it struck me that thirty years ago, when I began my medical studies, there certainly was nobody in London—nay, nobody in the world—who could have given you this course of instruction. We had not the instruments which are necessary to carry it out. The whole course of medical study since that time has been completely changed—in the first place, by discoveries made by the use of the microscope, and, in the second place, by that application of delicate instruments to the illustration of the mechanism of the body, which is the very essence and a great part of modern physiology. At that time even organic chemistry was hardly in existence. It is this recognition of the fact that the study of life is essentially a question of applied physics and chemistry which has changed the whole course of our medical studies. It is that which makes elaborate appliances necessary.

The main question raised by Prof. Huxley in these remarks is, in our opinion, really this: Are we in the future to mass our Faculties as they are massed in Germany, or are we to separate them as they are separated in France?

The altogether glorious mental activity of the Germans in the present century is undoubtedly due to the commingling of the teaching of the various Faculties, and to the University teaching universally available. In Germany it may be said that there are no provincial institutions, for the smallest universities are modelled on the largest, and are as perfect, so far as they go. The metropolis is thus carried into the provinces.

Contrast this with the condition of things in France, with its single University and special scientific schools, and where outside Paris there is no institution, so far as we are aware, where all the Faculties exist side by side, and are conducted with equal vigour. Medical Faculty here, Law Faculty there, Arts Faculty somewhere else, and Science Faculty again in another region; such is the condition which is now being severely criticised by many of the best minds in France. But it must be remembered that while the whole of France besides Paris is so lamentably provincial, in Paris itself there are facilities for advancing and distributing knowledge which put London *plus* Oxford and Cambridge to shame.

In provincial England we fear it may be said with too much truth that we are at the present moment behind France. It is clear that in Owens College we have an institution which will correct the existing condition of things on the German plan; in such institutions as the Yorkshire College of Science we have attempts to correct it on the French plan, a plan condemned utterly by the most far-seeing men in France itself; while we have not in England the corrective supplied by Paris, considered as a vast centre of teaching and research.

We are glad that Prof. Huxley has called attention to the importance of the step taken by Manchester, and has so clearly stated his idea of the right thing to be done for the advancement of the higher education.

Nor did he neglect to point out the intimate connection that must exist between this and the secondary education before any real progress can be made :—"You who commence your medical studies should come prepared with the outlines of physics and chemistry as your foundations. One of the great reasons of the backwardness of medical study is that those who come to study are, by reason of the lamentable defects of their common school education, utterly unprovided with a knowledge of what those physical studies mean. I wish to stamp upon your minds, as firmly and as strongly as it is burnt into my own, that all these appliances and all these mechanical aids for the study of medicine are simply thrown away unless they have the foundation of human hard work and clearheadedness to go upon."

Still another point of the most vital importance to the future progress of Science in this country was touched upon; we refer to Prof. Huxley's statement of opinion as to the importance of the Research Scholarships established at Owens College :—

"I notice in these donations and in these sums of money subscribed for the purpose of building and endowing and providing with scholarships this great institution, what appears to me to be a peculiar feature; at least I know nothing exactly like it anywhere else: and as it appears to me to be a feature of great importance and one which it is desirable to imitate as fast as possible by other educational bodies, you will pardon me if I dilate upon it for a short time. You have two scholarships which differ from the ordinary scholarships in this, that they are rewards not merely for learning, and not merely for careful attention and diligent study of that which the student may learn in the lecture-room or from books, but they are rewards which are given to those who exhibit in some degree that most valuable and most important of all intellectual gifts, the power of advancing truth by the pursuit of original research. I refer to the Dalton Scholarship and the Platt Scholarship. I can conceive no object more important at the present time than that of encouraging original research in science, and the way of doing it, without at the same time doing more harm than good, is one which has come very seriously under my consideration as one of the Royal Commissioners for the Advancement of Science, and I earnestly wish that we could look elsewhere to the solution of that problem by means analogous to those adopted here—I mean to say by private benefactors coming forward with their endowments, which endowments should benefit those only who are engaged in original research. The introduction of scholarships of this kind into the early life of young men, when it is so important that their attention should be directed to original research, is a new feature in this institution, and permit me to say, however important the institution may be in other respects, I am not sure that it is not one of the most important of its features."

It will be seen that while Prof. Huxley acknowledged the necessity for the endowment of unremunerative research, speaking as a Royal Commissioner, he acknowledged also that there are difficulties which surround the solution of the question. We are glad of this, because if the things were easy it would certainly not require that the machinery of a Royal Commission such as the one now sitting should be set in motion; nor, let us add, would it be worth Prof. Huxley's attention. In the fact that the question is a difficult one we see the best justification for the best minds in the country being brought to bear upon it, and we may safely anticipate a satisfactory solution.

THE REPORT OF THE METEOROLOGICAL COMMITTEE

Report of the Meteorological Committee of the Royal Society for the Year ending December 31, 1873. (London, 1874.)

THE proceedings of the Meteorological Committee of the Royal Society for 1873 are detailed in the above Report. The discussion of the meteorology of the district of the Atlantic Doldrums, known as Square 3, has now been completed, and this piece of work, which the Committee consider may fairly be termed a monograph for the district, will shortly be published. The examination of the eight squares adjacent to Square 3 has already been entered upon. The discussion of the results of Sir J. Ross's Antarctic expedition, from the observations made on board H.M.S. *Erebus* and *Terror* in 1840-43 and H.M.S. *Pagoda* in 1845, has also been completed and published, and is a paper of considerable value. Another good piece of work done by the Office is the examination, at the request of the Astronomer Royal, of the observations bearing on the meteorology of Kerguelen Island for the month of December, the results of which have been forwarded to those who are now stationed there to observe the transit of Venus.

We are glad to see that an increasing regularity in the receipt of the Weather Telegraphic Reports is notified, and we very cordially join in the regret expressed by the Committee that the Post Office authorities have declined to extend the telegraph wires so that a station might be established at Mullaghmore, near Sligo. In consequence of this action or want of action on the part of the Post Office, the Meteorological Office continues to be without daily information along the whole of the important and extended line of coast from Valencia to Lough Foyle. We hope that this blank will soon be filled up, and further, that some arrangement will be entered into by which a constant service will be maintained on the west coasts of these islands, and also at the Head Office in London; for until this be carried out, our system of weather telegraphy must, of necessity, not unfrequently fail to give warning of approaching storms. A comparison has been instituted, as in the three previous years, between the warnings issued and the weather experienced on our coasts, with the general result that the total success of warnings for 1873 was 79·2 per cent. as compared with 80·5 per cent. for 1872. In 1870 and 1871 the percentages of success were 68·4 and 63·7 respectively. The mean of these four years is nearly the same as that of the last two years when the office was under Admiral Fitzroy's management, but it will be observed that 1872 and 1873 show the largest number of successful warnings.

The restoration of Admiral Fitzroy's system of warnings, so far as to announce in the warning-message the probable direction of the apprehended storm, is a step which, we see at p. 51 of the "Report on Weather Telegraphy and Storm Warnings, presented to the Congress at Vienna," was strongly urged by the council of the Scottish Meteorological Society upwards of a year ago. The practical restoration of Fitzroy's system has been effected by the Committee, and the change took effect in March last, with, however, the very decided improvement of employing the drum simply to emphasize the warning given by the cone, instead of denoting, as it did originally, "dangerous winds from nearly opposite quarters successively." The Committee have attempted to assign the degree of probability to a storm announced by signal, thus: "Hitherto it has been found that at least *three* out of *five* signals of approaching storms (force upwards of 8 Beaufort scale, a fresh gale), and *four* out of *five* signals of approaching strong winds (force upwards of 6 Beaufort scale, a strong breeze), have been fully justified." We observe with some interest that the Committee have directed that tentative forecasts should be prepared daily in the office, and compared with the facts experienced subsequently, and that they hope ere very long to be able to afford the public the benefit of the information. For the successful development of the important question of weather probabilities, it will be necessary that the Committee investigate weather changes over a much wider area than is covered by the daily weather charts. In this direction, the reports begun to be received during 1873 from Sweden and Denmark will prove to be of considerable utility; but for the success of the experiment it will be necessary that daily reports be also received from points in the north-west of Russia, and in Germany, Austria, and Switzerland.

The anemometrical returns from Bermuda for four years have been published. These observations, and similar observations made at Sandwich, Orkney, previously published by the Committee, have been discussed by a method which cannot be recommended. The results are worth little, and altogether inadequate to the expense incurred in their discussion. The discussion of no meteorological data at all approaches in difficulty that of wind observations, and it is necessary at the outset to apprehend the difficulties to be overcome.

In several cases the language used in the Report is inexact and tends to mislead. Thus an excess of high winds on the coast of Scotland during 1873, and a deficiency on the coasts further south, are stated to be explained by the circumstance that in 1873 "the paths of the storm centres lay to the northward of the British Isles, so that our stations felt the barometrical and other meteorological disturbances, but were not exposed to the full force of the wind." Now, as is pretty well known among meteorologists, in previous years the immense majority of British storms have had their centres to the northward of the British Isles. The proximate cause of the peculiar distribution of storms of wind during 1873 lay not in the position of the paths of the storm-centres, but in the manner of the distribution over Great Britain of the steeper barometric gradients of the atmospheric depressions of the storms of 1873 as they swept eastwards over north-western Europe.

It would have been satisfactory if the comparison which has been instituted by the Office between the observations from Valencia, in Ireland, and Angra do Heroismo, in the Azores, had been detailed in the Report, seeing that it is inferred from the result, "beyond the possibility of a doubt, that reports from a station situated at the Azores would be practically useless to the Office in giving early intimation of approaching storms." The grounds of this strongly-expressed opinion on a point of some importance in weather telegraphy, and contrary to the views entertained by not a few meteorologists, ought to have been stated.

In the Committee's Quarterly Weather Report for 1870 the position of the thermometers at each of their seven observatories was described and figured. We hope that in the next Report a detailed account will be given of the position and exposure of the thermometers at the stations from which the daily telegraphic weather reports are sent, in order that meteorologists may judge how far the observations made at these stations might be available in investigating the climate of the British Isles, and in some other meteorological inquiries. This is by many deemed necessary, especially when it is considered that the Office has not hitherto published any mean temperatures from the daily observations made at their telegraphic stations, and some of these stations, particularly in Ireland, are in parts of the British Isles, of whose climate little is yet known.

GEOLOGY AND AGRICULTURE

Applications de Géologie et l'Agriculture, par M. Amédée Burat, Engineer, Professor at the Central School of Arts and Manufactures. (Paris: Rothschild, 1874.)

GEOLOGY is one of the most interesting of modern sciences. Soon after it assumed shape high hopes were entertained as to its value to the farmer: up to the present these hopes have not been realised. And yet the study of geology is most intimately connected with agricultural pursuits. Surface geology deals with the soil which daily occupies the thoughts and labours of the farmer. There is one phase of surface geology which has been almost wholly neglected of late; we refer to the connection between soils and the rock-formations from which soils have been derived. It is here possibly that there is the widest field for original research. It was hoped that this branch of agricultural science would have received much attention from the present secretary to the Royal Agricultural Society of England, who had previously been a diligent student of geology and secretary to the Geological Society. So far, his hands would appear to have been full of other work, and he has done little where much was expected.

That there is a most intimate connection between soils and rock-formations is well known. In some places the soil is the direct product of the disintegration of the underlying rock. It more frequently happens, however, that the soil has not been derived from the rock on which it rests, but consists of drifted material. The study of this drifted material is most interesting to the geologist, and ought to be most instructive to the farmer. It enables the geologist to understand the direction and force of former water-currents; and thus throws light on obscure phenomena. A careful examination of the drift enables us to trace the origin of the soil. Thus, for example, a study of the stones and pebbly particles of the soil, enables us not only to know the rocks from which it was derived, at all events partly, but also to understand the rate at which plant-food may become liberated on the soil by the disintegration of these very stones and pebbles. On this point a word of explanation may be here offered.

If we examine a fertile soil at any time we shall find that only a very small portion of its substance (seldom more than one per cent.) is in a condition fit for nourishing our crops, the great bulk of its substance being locked up in a condition at the moment unavailable. By the action of air, of moisture, of heat, and of manure, part of this unavailable matter becomes available for crops. It is on the rate at which the process of disintegration—or liberation of plant-food—takes place that the *natural* power of production of the soil chiefly depends. The study of agricultural geology from this point of view is manifestly of the highest scientific and practical importance: it opens up a wide field for original research. We had hoped, on receiving M. Burat's little volume, that he would have taken up the subject. We have been disappointed.

The work is, not, however, without merit. The language is simple, and the style as lucid as need be.

In the introduction the author leads the reader to expect a fuller exposition of the relation between geology and practical farming than he will find in the volume. The book contains four chapters. The first is a disquisition, couched in very general terms, on the physical characters and composition of soils. As an illustration of the very general character of the matter we quote the average composition of fertile soils (p. 8):—

Every 100 parts contain—

35 gravelly particles of the size of peas
45 ditto ditto millets
10 ditto of fine sand
10 ditto of fine material, separable by washing.

We are next furnished with a general "ultimate" chemical composition of an average soil. Information of this kind possesses no value except to the junior student.

The second chapter is devoted to manures, which are treated in a popular manner. The third chapter is on the action of water, and the subject is treated in an interesting manner; the services of the Abbé Paramere are duly acknowledged. The fourth, and last, is the most interesting chapter in the work. Here the author shows very clearly that there is a connection between geology and agriculture, drawing illustrations from the primary, secondary, and tertiary groups of rocks. Soils formed from granitic rocks are, in Great Britain and Ireland and elsewhere, deficient in lime. In our own experience we have seen most valuable results produced by the application of lime to these soils; and we learn from M. Burat that by the same means several districts in the West of France, which formerly were unable to maintain their people without extraneous supplies of food, have (*i.e.* by the use of lime) become the largest exporters of grain. All the author's illustrations are taken from France, but they have their counterparts in these islands.

On the whole, we are justified in saying that the little work will well repay perusal.

OUR BOOK SHELF

Flora of Dorsetshire. By J. C. Mansel-Pleydell. (London: Whittaker and Co. Blandford: W. Shipp.)

Flora Cravoniensis: or, a Flora of the Vicinity of Settle in Craven, Yorkshire. By John Windsor. (Manchester: Cave and Sever, 1873. Printed for private circulation.)

ALTHOUGH the boundary-lines of our counties are, as a rule, purely arbitrary, it is probably wise for the compilers of local floras to maintain them rather than to erect new ones of their own. The area of their observations is, at all events, thus rendered perfectly clear and certain. Dorset has long been famous for its palæontological wealth, both vegetable and animal; and we have here a record of its living flora, which, as might be expected from its length of sea-board and its variety of geological formations—lias, oolite, forest marble, Oxford clay, coral rag, Kimmeridge clay, Portland sand, Purbeck, chalk, and Eocene—is a rich one. The value of local floras depends greatly on the dependence that can be placed on the determination of the species by the editor and his *collaborateurs*; and on this point it seems to us that the present work can be safely trusted, great pains having been taken to establish the authenticity both of the localities and of the nomenclature. The county is divided into seven districts determined by the drainage, and therefore generally separated by high land; and a very good map of the county accompanies the volume. Among the greatest botanical rarities of the county (some of them almost unique) are—*Polycarpon tetraphyllum*, *Lotus hispidus*, *Simethis bicolor*, *Leucojum vernum* (doubtfully native), *Carex clandestina*, *Scirpus parvulus*, and *Cynodon dactylon*. The flora is confined to flowering plants and vascular cryptogams.

Mr. Windsor's "Flora of Craven" (the veteran author did not live to see its publication, or rather printing) is compiled on a different plan, the area being a somewhat arbitrary one: "about Settle and its neighbourhood to a moderate distance, generally within twelve miles, but in a few instances extending somewhat further." The district is a remarkably interesting one, whether from a geological or a botanical point of view; and the flora has been compiled with as great care as in the other case under notice, with the assistance of several good local botanists, and includes not only the flowering plants and vascular cryptogams, but also the Characeæ, Mosses, Hepaticæ, and Lichens. A district that includes among its native plants such rarities as *Polemonium cœruleum*, *Epipactis ovalis*, and *Cypripedium calceolus*, is of no ordinary interest.

Both these volumes are useful contributions to our library of local botany. We would especially commend to compilers of similar works the plan adopted by Mr. Mansel-Pleydell, of giving the geographical range of each species in the neighbouring counties of England and on the opposite coast of France.

A. W. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Migration of Birds

THE subject to which Prof. Newton has called attention is one of great interest to all naturalists, and requires to be studied systematically; for I can hardly think that the solution is so "simple in the extreme" as Mr. Newton thinks it may be.

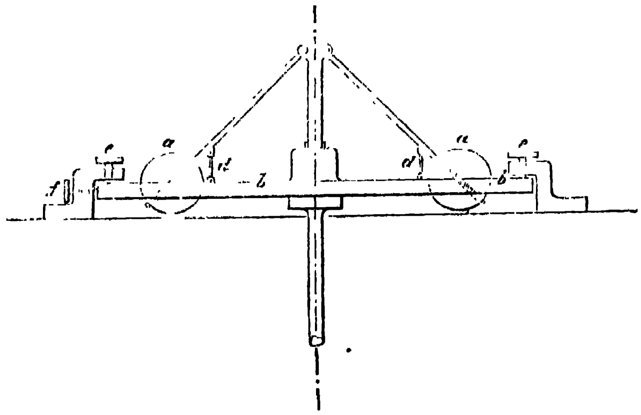
It appears to me probable that here, as in so many other cases, "survival of the fittest" will be found to have had a powerful influence. Let us suppose that in any species of migratory bird, breeding can as a rule be only safely accomplished in a given area; and further, that during a great part of the rest of the year sufficient food cannot be obtained in that area. It will follow that those birds which do not leave the breeding area at the proper season will suffer, and ultimately become extinct; which will also be the fate of those which do not leave the feeding area at the proper time. Now, if we suppose that the two areas were (for some remote ancestor of the existing species) coincident, but by geological and climatic changes gradually diverged from each other, we can easily understand how the habit of incipient and partial migration at the proper seasons would at last become hereditary, and so fixed as to be what we term an instinct. It will probably be found, that every gradation still exists in various parts of the world, from a complete coincidence to a complete separation of the breeding and the subsistence areas; and when the natural history of a sufficient number of species in all parts of the world is thoroughly worked out, we may find every link between species which never leave a restricted area in which they breed and live the whole year round, to those other cases in which the two areas are absolutely separated. The actual causes that determine the exact time, year by year, at which certain species migrate, will of course be difficult to ascertain. I would suggest, however, that they will be found to depend on those climatal changes which most affect the particular species. The change of colour, or the fall, of certain leaves; the change to the pupa state of certain insects; prevalent winds or rains; or even the decreased temperature of the earth and water, may all have their influence. Ample materials must exist, in the case of European birds, for an instructive work on this subject. The two areas should be carefully determined for a number of migratory birds; the times of their movements should be compared with a variety of natural phenomena likely to influence them; the past changes of surface, of climate, and of vegetation should be taken account of; and there seems no reason to doubt that such a mode of research would throw much light on, if it did not completely solve, the problem.

This is an appropriate opportunity for making a suggestion which has long been in my mind. It is, that it would be a valuable and interesting addition to NATURE, if we were supplied with a weekly (or monthly) "Calendar of Periodical Phenomena in Natural History," such as the average dates of appearance and departure of migratory birds, of the opening and fall of the leaf of our forest trees and common cultivated trees and shrubs; of the flowering of our common field and garden plants; and also the mean *highest* and *lowest* temperature of each *day*, the direction of the wind and amount of rainfall for each *week*, according to the Greenwich averages. None of this information is given in the usual almanacks or periodicals, and it is by no means easy to find it when wanted. Yet it is surely of much value to everyone who lives in the country, and would be the means of exciting an intelligent interest in such observations and inquiries as those to which Prof. Newton has called our attention in his interesting article.

ALFRED R. WALLACE

Regular Motion in Clockwork

IN order to ensure perfectly regular motion in the clockwork which drives the revolving dioptric apparatus made by Messrs. Chance, Bros. and Co., I have recently introduced a centrifugal governor, which might perhaps also be useful for the clocks of equatorials. Though it involves nothing new in principle, the form differs from anything I have seen, in that the governor balls have to lift a heavy weight, and that the leather rubbers or brushes are not carried by the revolving balls, but are fixed to the frame of the clock and rub against the disc which forms the extra weight lifted by the balls. The sketch shows the governor in use on the clock of the apparatus of Cape Bon, Tunis, an apparatus exactly similar to that now standing in the International Exhibition. It consists of a shaft making 170 revolutions per minute, to which the balls *a a* are hung, and on which the disc *b b* can slide, guided by a feather key. When the clock is below speed the disc rests upon a collar fixed on the shaft, the pull exerted by the balls through the links *d d* being insufficient to raise it; but as soon as the proper speed is attained, the disc rises and comes in contact with the screws *e e*, which are tipped with leather and fixed to the frame of the clock. Spaces are cut out of the disc to admit the balls, avoiding unnecessary height. The screw *f* serves as a brake to stop the clock at pleasure. I calculate that work to the extent of five foot-pounds per minute must be done on the governor to accelerate the clock one second per hour. This form possesses two advantages over that in which the rubbers are carried by the balls—1. It checks any acceleration of the clock more powerfully; 2. It is easier to adjust. In the older form it is necessary to ascertain by careful experiment that *each* ball shall bring its rubber into contact exactly when the speed is correct, whereas in this it is immaterial that the arms of the balls should be exactly equal; it is only needful that they should *together* raise the disc to contact when the speed is right.



J. Hopkinson

Glass Works, near Birmingham, Sept 1

Rainbows

As a pendant to my note inserted in Nature, vol. x. p. 437, I may mention that an exceedingly fine lunar rainbow was observed here at 8.40 P.M. on September 29.

Though the moon was near the last quarter, the bow was bright enough to appear reddish on one side and greenish on the other. It is the only one, of some five or six lunar rainbows I have seen, which appeared to show any trace of differences of colour.

I may also mention that about the end of August I saw, two hours after sunrise, a dazzlingly bright and gorgeously coloured parhelion in a small ice-cloud to the right of the sun, the rest of the sky being almost perfectly clear. There had been a sudden and considerable fall of temperature during the previous night.

St. Andrew's, Oct. 2 P. G. Tait

In Nature, vol. x. p. 438, Mr. Schuster complains that in text-books no mention is made of supernumerary rainbows, and that the theory of them is to be sought in original memoirs, not generally accessible. Allow me to mention that in Sir John Herschel's Meteorology (a little work published by Black, price three and sixpence, and originally an article in the Encycl. Britann.), a complete explanation of the rainbow, and of the supernumerary bows as well, on the principle of interference, is to be found. F.M.S.

U.S. Weather Maps

In Prof. Loomis's "Results of an Examination of the U.S. Weather Maps for 1872 and 1873" (published in the *American Journal of Science and Arts*, and recently noticed in Nature, I am struck not only by the general agreement but by the almost verbal coincidence of one or two of his "Results" with some of the rules laid down in my work on the "Laws of the Winds prevailing in Western Europe," which was published in the beginning of 1872.

In "Laws of the Winds," Part I. p. 56 and following, I have shown that "we are unable to account for the eastward progress of depressions by attributing it to prevailing westerly upper-currents," but that "each system of depression appears to travel eastward with a kind of self-developed motion," and that the precipitation on the east side of the centre "is the principal agent in producing the change of geographical position." Prof. Loomis writes: "The progress of a storm eastward is not wholly due to a drifting resulting from the influence of an upper-current from the west, but the storm works its way eastward in consequence of the greater precipitation on the eastern side of the storm."

Prof. Loomis also appears to attribute the formation of some depressions, primarily developed in the United States, to the collision of moist air from the Pacific with the mountains in the north and west, in the same way as I have attributed the primary formation of some of our depressions to the collision of the vapour-laden atmosphere from the Atlantic with the high-lands in the west and north of the British Isles.

I am glad to observe that Prof. Loomis is no advocate of the "circular theory" of storms as still held by some meteorologists. He intimates the mean inclination of the wind towards the lower isobars as "more than 45°" in the United States. In the Journal of the Scottish Meteorological Society, No. xxxix. I have shown that at stations in the British Isles the mean inclination is 21°, but that it appears to be considerably higher in continental Europe.

In the work previously alluded to I have shown that depressions appear to travel most to the south when the atmosphere is warmer in the west than in the east, and most to the north under contrary circumstances, but that this influence is interfered with by another, viz., the tendency of depressions to travel so as to have the highest general pressures on their right. A less limited acquaintance even than I can claim with the U S. Weather Maps would go far to show which of these two influences is the predominant, the general atmospheric conditions of the United States presenting a better field for their investigation than is to be obtained in Europe. Prof. Loomis finds that in North America storms tend most to the south in July and to the north in October. It would be interesting to inquire whether this observation holds good of depressions on the Pacific coast, as well as near the Atlantic. But a two years' average is insufficient to settle such questions.

On the whole it is satisfactory to find that some important results obtained from a study of European weather-charts are found, on good authority, to be in accordance with those derived from the U.S. maps. At the same time some of the theoretical remarks made by Prof. Loomis will not, I think, be generally endorsed by meteorologists. The statement that "it needs no argument to prove that when the wind is flowing from all quarters inwards upon a central area, there is a rapid accumulation of air, which can only escape by an upward motion," is incorrect; the depression of the barometer in the centre showing that there is no accumulation, but a rarefaction, produced in part, as Prof. Loomis has himself previously shown, by precipitation, and which is itself the cause of the influx.

Under the present conditions of anemometry all endeavours to calculate the upward movement in a storm from anemometrical data should also be accepted with much reserve. Still more hazardous (considering the inclination of depression-axes and the frequent difference of direction between currents at small and those at great elevations) is the attempt, in such an inquiry, to correct the observed velocities at sea-level by those on the summit of Mount Washington. With a depression in Eastern Canada a west wind not uncommonly blows on Mount Washington while more southerly airs are felt at the three nearest stations. If in such a case we calculate the amount of influx towards the depression-centre simply from the ratio between the velocity at sea-level and that on Mount Washington, it is obvious that the result will be the reverse of accurate.

Aug. 25 W. Clement Ley

Aurora

On Sept. 11 I was at Kyle Akin (Skye). The day had been wet and stormy, but towards evening the wind fell and the sky became clear. About 10 P.M. my attention was drawn to a beautiful auroral display. No crimson or rose tint was to be seen, but a long low-lying arc of the purest white light wa formed in the north, and continued to shine with more or less brilliancy for some time. The arc appeared to be a double one, by the presence of a dark band running longitudinally through it. Occasional streamers of equally pure white light ran upwards from either end of the bow. The moon was only a day old, but the old landscape was lighted up as if by the full moon; and the effect of Kyle Akin lighthouse, the numerous surrounding islands, and the still sea between, was a true thing of beauty, forming as it did a quiet contrast to the more brilliant but restless forms of auroræ generally seen. I particularly noticed a somewhat misty and foggy look about the brilliant arc, giving it almost a solid appearance. The space of sky between the horizon and the lower edge of the arc was of a deep indigo colour, probably the effect of contrast.

I regretted I had no spectroscope with me, as it would have been a fine opportunity to test the spectrum of an aurora of pure white light. I had a strong impression that the bow was near to the earth, and almost thought that the eastern end, and some fleecy clouds in which it was involved, were between myself and the peaks of some distant mountains. The eye is, however, deceptive in such cases, though instances are not wanting of auroræ close to the earth's surface. I shall be glad to know if other observations of this aurora were made.

Nairn, N.B., Oct. 3 J. RAND CAPRON

The Cry of the Frog

THE fact that the common frog (*Rana temporaria*) is capable of crying out lustily when he feels himself in danger, does not seem to have been frequently remarked. In my small walled garden there is a common frog who is persecuted by three cats. His residence is a heap of slates at the foot of an ivied wall, and here he is safe. But if he ventures far abroad his tormentors soon espy him, and though they seem nearly as much terrified as himself, they cannot resist the temptation to touch him with their paws. He immediately opens his mouth and utters a prolonged cry, which appears to be very surprising to the cats, who draw back for a few moments, and then pat him again, apparently out of mere curiosity, to be again scared by the same unusual sound. This sound is a shrill and rather sibilant wail, like the note of a small penny trumpet or the cry of a new-born infant. There can be no mistake about it, as I have repeatedly touched the frog with my own hand after driving the cats away, and the same cry has immediately followed, the lower jaw being dropped so that the mouth stands open about a quarter of an inch at the tip.

Leicester, Sept. 26 F. T. MOTT

The Woolwich Aeronautical Experiment

II.

IN order to discover the laws of the vertical motion, we must suppose that the balloon is resting in perfect equilibrium when on land; which means that the ascending power of the gas enclosed in the balloon is just equal to the weight of the canvas, netting, grapnel, ballast, passengers, &c. Under these circumstances the balloon will not ascend by itself, but it will with all the weight of the sand which may be thrown overboard, if a certain space is left for dilatation and the balloon is not quite full when resting on land. If the volume is V at the surface of earth, it will be $\frac{V\,H}{h}$ at an altitude where barometric pressure is h, being H at departure. When the balloon is quite full, gas escapes by the lower part under the shape of a whitish steam. If v is the additional volume which can be filled by dilatation, that phenomenon will take place at an altitude where the pressure is h given by the equation $\frac{V\,H}{V+v}$:

We suppose that the height h is never to be attained, and in fact it is desirable for the aëronauts to limit their altitude before starting, and not to fill their balloon with a gas which they are obliged to throw away by the valve or to see escaping by the *appendice* at some risk of their own safety; one of the greatest advantages of the vertical fan being to limit at will the ascent, as will be shown.

In our calculations we suppose that the canvas is not losing gas, that the sun is not affecting the balloon, and that no water is falling upon it, or no cloud concealing the sun. All these changes of temperature can be made the subject of special calculations, and the real motion of the aërostatic globe is the *mean* between all the different circumstances of the atmosphere.

If a balloon starts in an homogeneous air because a weight p of sand was thrown overboard, P being the weight of the air displaced by the balloon when resting on land, the motive power is $g' = \frac{g\,p}{P+p}$ and the laws of the motions of an Attwood machine are perfectly applicable to it.

The elevation takes place with an increased velocity up to the moment where the resistance of the air is to g'. Consequently,

$$K v^2 = \frac{p\,g}{P+p}.$$

K being a certain coefficient which depends on the form of the balloon, its diameter, its netting, and the density of the air. K diminishes as the altitude increases, but the diameter of the balloon enlarges gradually to its utmost. As the law of diminution of pressure is not known, we are obliged to suppose K = constant.

If we suppose a balloon of 60,000 cubic feet holding 50,000 cubic feet of gas when resting on the ground, the balloon can reach without losing gas (except by the loss through the canvas, which we suppose to be perfectly gas-tight) to a level where $h' = \frac{5\,h}{6}$ = about 6,000 feet in round numbers. Under these circumstances the weight of the balloon when resting on land may be supposed to be about 3,300 pounds.

If we suppose 20 lbs. of sand are thrown overboard in ascending, the motive power will be $\frac{g}{115}$. The uniform motion will be $Kv^2 = \frac{g}{115}$.

Under these circumstances, as far as my knowledge goes, it is 4 ft. per second. If we suppose $g = 32$ feet.

$$Kv^2 = 16\ K = \frac{32}{115} \text{ and } K = \frac{32}{115 \times 16} = \frac{2}{115}$$

If a static effort of 20 lbs. in the vertical direction can be produced by the working of the vertical fan, it is easy to understand that the ascent can be stopped before the balloon has reached the level where the gas is beginning to escape by working in the proper direction for it. That effort is not too much for two men working on a fan which is suitably constructed.

The same thing can be said as to the descent of the balloon, but K is much larger, as the shape of the lower part is not so well suited for moving in the air as the upper half. With *appendice*, netting, ropes, and car, it exerts a resistance which is much larger and may be compared with the force exerted by a *parachute* descending in the air. The difference is very great, as I observed several times in my ascents that it was difficult to give the balloon a descending impulsion towards the land. I should not wonder if it was partly the cause of the resistance felt by Mr. Bowdler when moving his fan in the direction where it ought to have caused the balloon to descend; at least such is the opinion that I am in position to hold from the concise and imperfect narrative I found in the public papers.

W. DE FONVIELLE

Is the Rabbit Indigenous?

WOULD you permit me, through the medium of NATURE, to ask on what grounds the rabbit is considered not indigenous in this country? The best authorities on British and German Mammalia seem agreed that it is a native of the Mediterranean basin. On what facts or writings is this opinion based, and at what time was it introduced into Great Britain? I am very anxious to determine whether the above statements are founded on authentic documents or writings, or are merely suppositions which cannot be asserted with certainty. N.

Sept. 30

THE SOCIAL SCIENCE CONGRESS

THE friends of social science have had a most successful meeting this year at Glasgow, and in the various addresses and papers there has been afforded ample evidence that the importance of the introduction of more scientific knowledge into the heads and daily life of the people is becoming more and more widely acknowledged.

In the Health Section, Dr. Lyon Playfair in his address, after referring to Franklin's aphorism, "Public health is public wealth," pointed out that taking the smallest part of the money saving, it is obvious that money judiciously spent in sanitary improvement is not unproductive taxation, but capital bearing abundant interest; and he then gave an idea of the present sanitary chaos. "In England, at the present time, there is a casual agglomeration of 1,500 separate sanitary authorities, without system or cohesion. Their areas of administration are diverse in the extreme, being neither bounded by counties, parishes, nor natural watersheds; and their duties are divided without meaning between authorities in the same district. They have been lately put under medical officers of health without preparation or qualifications for their duties, some well paid and devoting their time to this important work, others having little more than nominal payment, and giving little more than nominal time to their important duties. Notwithstanding this too sudden and unprepared universal appointment of medical officers, yet in the administration of the Health Acts there has been recently manifested a disposition to 'distrust the doctors,' and to work the Acts, at least at head-quarters, by lawyers and other persons not connected with the medical profession. This is the old error of making common sense the fetish for worship, which Archbishop Whately and others have so effectively condemned. Even the most fervent worshipper of common sense as opposed to technical training never relies on it in important emergencies of his life. He goes to the lawyer to make his will or to convey property; he consults the parson on religious doubts when on the sick bed, and he does not spurn the doctor to cure him of his grievous ailment. But it is well known that the Local Government Board are afraid of the doctors in the administration of Health Acts. Who beside them possess the knowledge? I can testify, from an experience of thirty years in sanitary work—and impartially, because I am not in the medical profession—that there is not a class of men in the country who labour so zealously for the prevention of disease as the doctors, though their training hitherto has been cure, not prevention. Certainly their private interests have never been allowed to stand in the way of their efforts to uproot disease, although their living depends upon its existence. This unselfishness in the application of their science to prevention has always been to me a source of high admiration. Why, then, is there this vulgar distrust of the doctors in the administration of our Health Acts? Extend this prejudice against technical knowledge, and how absurd it would be. Would you improve the progress of telegraphy in this country by suppressing electricians, or the law and justice of the country by putting down lawyers? Would the Secretary at War promote the conduct of war by suspecting soldiers, or the First Lord of the Admiralty the efficiency of fleets by distrusting sailors? Would our railroads and harbours be better governed if engineers were held at a discount? But this is actually the state of things at the Local Government Board—the Health Ministry of the country. The Privy Council handed over to that Board Dr. Simon and his associates, with a wealth of medical experience in public hygiene. Ever since, that wealth has been locked away from public use. Certain I am that their experience could not have guided the Board in the utter confusion of organisation in regard to medical officers of health. They have been appointed without any system. Some have a small parish to attend to, others have a thousand square miles. The last are appointed for combined districts, but are managed by uncombined authorities, and have neither assistants to aid them nor power to enforce their decisions. The officers of health are without any definite rule for obtaining available knowledge of prevailing sickness, even when it is treated at the public expense within their own districts; and they are not, universally at least, informed of the deaths as they occur. The medical officers of health have been appointed without any examination on their knowledge of State medicine, and in the majority of cases they do not possess this knowledge. I am perfectly certain that this utter confusion could not have resulted had the Local Government Board consulted the experienced State medical officers belonging to them. This distrust of the doctors in higher administration is simply a general mistrust of science. And the time has now arrived when science must be trusted in government. Science is entering into the higher education of the country, and the prejudice against it among legislators, who were educated in classical universities, will in time be removed. For the progress of a country depends upon the progress of science, and the welfare of a nation is secured by the most intelligent application of science to its manufactures and to its government. The health of the country—and that governs the productive power of its people—depends as much upon the application of medical science as the working of a machine depends upon a good application of mechanical laws. To trust the whole administration of Health Acts to Poor-law inspectors and lawyers is an amazing example of unbelief in the first principles of the laws of health. The well-being of the people depends upon physical causes, which, when intelligently understood, mean physical science, and the trained physician is the natural and most intelligent agent for extending its knowledge and application to the prevention of disease. What we want in the future is not new law, but more efficient administration of existing law. To heap up new sanitary law on the decaying mass of undigested sanitary law, which already forms a dismal agglomeration, is like the practice of our ancestors, who thought that a few clean rushes thrown upon the corrupt mass of foul rushes on the floor sufficed for sanitary purposes. What we want is superior organisation and efficient administration of existing law. But, in our happy-go-lucky style of government, are we likely to get it? I doubt whether it will be wise to continue the Local Government as a separate department of the State. Its functions in reality appertain to the Home Office, which, when properly organised, should divide itself into two great departments, the one dealing with police and justice, the other with the physical interests of the people. One Secretary of State might have the supreme responsibility, but each of the divisions should be scientifically administered. It would be as absurd to put a man trained in physical science at the head of the branch of police and justice, as it is to put a man merely trained in law in charge of the physical interests of the people. It is an exploded fallacy that only lawyers are good men of business, and that scientific men are not. Is my friend Sir John Lubbock a worse banker because he is an eminent man of science? Is Mr. Spottiswoode a worse printer because he has distinguished himself as a physicist? Is Mr. Warren De la Rue a worse stationer because he is equally conspicuous as an astronomer and as a chemist? The Local Government of the country, in as far as it relates to the physical interests of the people, will remain an example of arrested development, unless science receives a recognised position in its administration."

In the Education Section there was nothing to call for notice in the address, but Mr. C. S. Parker drew attention to the Report of the Universities Inquiry Committee, and an interesting discussion followed.

The revenues of Oxford and Cambridge were reported by the Royal Commission appointed on the advice of Mr. Gladstone to be for the University, Colleges, and Halls of Oxford, 414,000*l.*, or, including prospective increase in the next fifteen years, 538,000*l.*; and for the University and Colleges of Cambridge, 340,000*l.*, or, including prospective increase, 380,000*l.* Making certain deductions from these totals, the net income was for Oxford 350,000*l.*, and for Cambridge 300,000*l.*; or, deducting again what was levied by taxation from their own members, the net endowments for Oxford and Cambridge Universities respectively were 300,000*l.* and 250,000*l.* The largest item of expenditure was to Fellows of Colleges—Oxford, 102,000*l.*; Cambridge, 103,000*l.* The smallest item was for scientific institutions, being under 2,000*l.* for each University. Mr. Parker remarked that this was hardly what might have been expected by the general public. A satirical person might even suggest as an improvement the reversal of the order. Seriously, the distribution came to this. Taking the residents in the University at about 400 graduates and 1,400 undergraduates, almost all the former and about half the latter received substantial aid from endowments. Mr. Parker examined various schemes which had been put forward, and expressed an opinion that, provided the central life were maintained with vigour, it was much to be desired that the Universities should occupy themselves with extending their connections throughout the country. Looking to their examinations in every quarter, 44,000*l.* at Oxford or 33,000*l.* at Cambridge was by no means excessive for Scholarships and Exhibitions. Some Exhibitions should be separately competed for by the unattached students who were now pursuing their studies at the Universities with so much success and at so little expense—in many cases under 50*l.* a year. To carry out needed reforms some central guidance would be necessary, either from a body appointed by the Universities themselves or, more probably, from a Parliamentary Executive Commission. But if such a Commission should be appointed, it was desirable the public should understand that it had not to deal with a retrograde, obstinate, or lethargic corporation, but to cooperate with the Universities and Colleges. Oxford and Cambridge, in respect of learning, had not held their own against the great German Universities, but a change had begun, and in Mr. Parker's opinion they were yearly commanding more respect throughout Europe.

In the discussion which followed, the Hon. G. Brodrick deprecated an attempt to subsidise, at the expense of Oxford and Cambridge, wealthy towns which, had they existed in America, would long ago have provided Universities of their own. On no account should resources which ought to be concentrated upon Oxford be frittered away upon the great cities of England and Scotland.

Sir G. Campbell said that in his belief it was these endowments which seemed to render reform impossible. They acted as an immense bribe to a continuance of the old monkish form of education, which he believed to be a mere superstition. He believed that the devotion of the time and talent of our youth to the learning of the regular verbs of Greek and Latin, and even the higher mathematics, was a gymnastic, and not a practical education. If endowments were to be continued, they must be taken in hand and, apart from the wills of founders, devoted to those branches of education which experience showed to be really useful and practical.

An important paper On the place of technical education was presented to the Section by Mr. B. Samuelson, M.P. This we shall give on a future occasion.

PITCHER-PLANT INSECTS*

THE insect-catching powers of these curious plants, the Flytraps (Dionæa), the Sundews (Drosera), and the Trumpet-leaves (Sarracenia), have always attracted the attention of the curious, but renewed interest has been awakened in them by virtue of the interesting experiments and observations on their structure, habit, and function, that have lately been recorded, and especially by the summing up of these observations in some charming papers by Prof. Asa Gray, which recently appeared in the *Nation* and the *New York Tribune* under the title of "Insectivorous Plants."

Through the courtesy of Dr. J. H. Mellichamp, of Bluffton, and of H. W. Ravenel, of Aiken, S.C., who have sent me abundant material, I am able to submit the following notes of an entomological bearing on the Spotted Trumpet-leaf (*Sarracenia variolaris*), which must henceforth rank with the plants of the other genera mentioned as a consummate insect catcher and devourer.

The leaf of Sarracenia is, briefly, a trumpet-shaped tube with an arched lid, covering, more or less completely, the mouth. The inner surface, from the mouth to about midway down the funnel, is covered with a compact decurved pubescence which is perfectly smooth and velvety to the touch, especially as the finger passes downward. From midway it is beset with retrorse bristles, which gradually increase in size till within a short distance of the bottom, where they suddenly cease, and the surface is smooth. There are also similar bristles under the lid. Running up the front of the trumpet is a broad wing with a hardened emarginate border, parting at the top and extending around the rim of the pitcher. Along this border, as Dr. Mellichamp discovered, but especially for a short distance inside the mouth, and less conspicuously inside the lid, there exude drops of a sweetened, viscid fluid, which, as the leaf matures, is replaced by a white, papery, tasteless, or but slightly sweetened sediment or efflorescence; while at the smooth bottom of the pitcher is secreted a limpid fluid possessing toxic or inebriating qualities.

The insects which meet their death in this fluid are numerous and of all orders. Ants are the principal victims, and the acidulous properties which their decomposing bodies give to the liquid doubtless render it all the more potent as a solvent. Scarcely any other Hymenoptera are found in the rotting mass, and it is an interesting fact that Dr. Mellichamp never found the little nectar-loving bee or other Mellifera about the plants. On one occasion only have I found in the pitcher the recognisable remains of a Bombus, and on one occasion only has he found the honey-bee captured. Species belonging to all the other orders are captured, and among the other species that I have most commonly met with, which, from the toughness of their chitinous integument, resist disorganisation and remain recognisable, may be mentioned *Asaphes memnonius* and *Euryomia melancholica* among Coleoptera, *Rentatoma higens* and *Orsilochus variabilis*, var. *complicatus*, among Heteroptera; while kyatids, locusts, crickets, cockroaches, flies, moths, and even butterflies, and some Arachnida and Myriapoda, in a more or less irrecognisable condition, frequently help to swell the unsavoury mass.

But while these insects are decoyed and macerated in order, as we may naturally infer, to help to support the destroyer, there are, nevertheless, two species which are proof against its siren influences, and which, in turn, oblige it either directly or indirectly to support them.

The first is *Xanthoptera semicrocea* Guen., a little glossy moth, which may properly be called the Sarraconia Moth. It is strikingly marked with grey-black and straw-yellow, the colours being sharply separated across the shoulders and the middle of the front wings. This little moth walks with perfect impunity over the inner surface of the pitcher, which proves so treacherous to so many other insects. It is frequently found in pairs within the pitchers soon after these open, in the early part of the season or about the end of April. The female lays her eggs singly, near the mouth of the pitcher, and the young larva, from the moment of hatching, spins for itself a carpet of silk and very soon closes up the mouth by drawing the rims together and covering them with a delicate, gossamer-like web, which effectually debars all small outside intruders. It then frets the leaf within, commencing under the hood and feeding downward on the cellular tissue, leaving only the epidermis. As it proceeds the lower part of the pitcher above the putrescent insect collection becomes packed with ochreous excrementitious droppings, and by the time the worm has attained its full size the pitcher above these droppings generally collapses. This worm when full grown is beautifully banded transversely with white and purple or lake red, which Dr. Mellichamp poetically likens in brightness to the Tyrian dye. It is furthermore characterised by rows of tubercles, which are especially prominent on the four larger legless joints. It is a half looper, having but six prolegs, and keeps up, in travelling, a constant restless, waving motion of the head and thoracic joints, recalling *paralysis agitans.* The chrysalis is formed in a very slight cocoon, usually just above or within the packed excrement. The species, kindly determined by Mr. A. R. Grote, was many years ago figured by Abbott, who found it feeding on *Sarracenia variolaris*, in Georgia. Guenée's descriptions were made from these figures, for which reason I append [the more technical matter relating to the species is here omitted] a few descriptive notes from the living material. It feeds alike on *S. variolaris* and *S. flava*, and there are two broods each year, the first brood of larvæ found during the early part of May, the second toward the end of June, and disappearing with the dying of the leaves, the latter part of July.

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* A paper read by Prof. C. V. Riley, of St. Louis, Mo., before the American Association for the Advancement of Science, August 1874.

The second species is a still more invariable living accompaniment of both kinds of Sarracenia mentioned. By the time the whitish efflorescence shows around the mouth of the pitcher, the moist and macerated insect-remains at the bottom will be found to almost invariably contain a single whitish, legless, grub or "gentile," about as large round as a goose-quill, tapering to the retractile head, which is furnished with two curved, black, sharp hooks, truncated and concave at the posterior end of the body.

This worm riots in the putrid insect remains, and when fed upon them to repletion bores through the leaf just above the petiole and burrows into the ground. Here it contracts to the pupa state, and in a few days issues as a large two-winged fly, which I have described in the Transactions of the St. Louis Academy of Science as *Sarcophaga sarraceniæ*—the Sarracenia Flesh-fly.

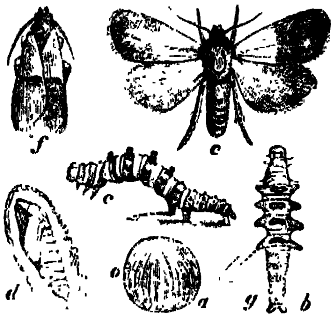

FIG. 1.—*Xanthoptera Semicrocea.* *a*, egg, enlarged, the natural size indicated at side; *b*, *c*, larva, back and side views; *d*, chrysalis: *e*, moth, normal form, with wings expanded; *f*, pale variety with wings closed.

The immense prolificacy of the Flesh-flies, and the fact that the young are hatched in the ovaries of the parent before they are deposited by her on tainted meat and other decomposing or strong-smelling substances, have long been known to entomologists, as has also the rapid development of the species. The viviparous habit among the Muscidæ is far more common than is generally supposed, and I have even known it to occur with the common house-fly, which normally lays eggs. It is also possessed by some Œstridæ, as I have shown in treating of *Œstrus ovis*, the Sheep Bot-fly.

But the propensity of the larvæ for killing one another and their ability to adapt themselves to different conditions of food supply are not sufficiently appreciated. I have long since known, from extensive rearing of parasitic Tachinidæ, that when, as is often the case, a half-dozen or more eggs are fastened to some caterpillar victim only large enough to nourish one to maturity, they all hatch and commence upon their common prey, but that the weaker eventually succumb to the strongest and oldest one, which finds the juices of his less fortunate brethren as much to his taste as those of the victimised caterpillar. Or, again, that where the food-supply is limited in quantity, as it often is and must be with insects whose larvæ are parasitic or sarcophagous, such larvæ have a far greater power of adapting themselves to the conditions in which they find themselves placed, than have herbivorous species under like circumstances.

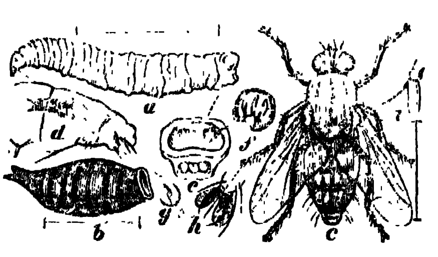

FIG. 2.—*Sarcophaga Sarraceniæ.* *a*, larva; *b*. pupa. *c*, fly, the hair lines showing average natural lengths; *d*, enlarged head and first joint of larva, showing curved hooks, lower lip (*g*), and prothoracic spiracle; *e*, end of body of same, showing stigmata (*f*) and prolegs and vent; *h*, tarsal claws of fly with protecting pads; *i*, antenna of same. All enlarged.

Both these characteristics are strongly illustrated in *Sarcophaga sarraceniæ*. Several larvæ, and often upwards of a dozen, are generally dropped by the parent fly within the pitcher; yet a fratricidal warfare is waged until usually but one matures, even where there appears macerated food enough for several. And if the Xanthoptera larva closes up the mouth of the pitcher ere a sufficient supply of insects have been captured to properly nourish it, this Sarcophaga larva will nevertheless undergo its transformations, though it sometimes has not strength enough to bore its way out, and the diminutive fly escapes from the puparium, only to find itself a prisoner unless deliverance comes in the rupture or perforation of the pitcher by the moth larva or by other means. This rupturing of the pitcher does not unfrequently take place, for Dr. Mellichamp writes under date of June 27 as follows:—"Most old leaves now examined—I might almost say all—instead of being bored, seem ripped or torn, as if by violence, apparently from without. You see occasionally shreds of the leaves hanging. Surely the legless larva of Sarcophaga cannot do this! What then—toads, or frogs, or crawfish abounding in these moist, pine lands? or rather is not the fat maggot the occasion of the visits of the quail which lately I have observed here?"

[Here follow some technical facts and descriptions of interest only to specialists.]

These two insects are the only species of any size that can invade the death-dealing trap with impunity while the leaf is in full vigour, and the only other species which seem at home in the leaf are a minute pale mite belonging apparently to *Holothyrus*, in the Gamasidæ, and which may quite commonly be found crawling within the pitcher; and a small Lepidopterous leaf-miner, which I have not succeeded in rearing. There must, however, be a fifth species, which effectually braves the dangers of the bottom of the pit, for the pupa of Sarcophaga is sometimes crowded with a little chalcid parasite, the parent of which must have sought her victim while it was rioting there, as larva.

But all other insects, so far as we know, tumble into the tube and there meet their death. The moth is doubtless assisted in walking within the tube by the spurs on the legs which it, in common with most other moths, possesses; while the Flesh-fly manages to hold its own by its widely extended legs and stout bristles. Dr. Mellichamp says that when disturbed it buzzes violently about, just as if an animated sheep bur had fallen into the tube—not apt to go down, because it will hitch and stick, and finally, by main force, it generally emerges, but once in a while also succumbs.

Two questions very naturally present themselves here:—(1) What gives the Flesh-fly more secure foothold on the slippery pubescence than the common house-fly exhibits? (2) What enables the larva of the Flesh-fly to withstand the solvent property of the fluid which destroys so many other insects? I can only offer, in answer, the following suggestions: the last joint of the tarsus of the common house-fly has two movable, sharp-pointed claws and a pair of pads or "pulvilli." These pads were formerly supposed to operate as suckers, and all sorts of sensational accounts of this wonderful sucker have been given by popular writers, who forgot that there are any number of minute insects having no such tarsal apparatus, which are equally indifferent to the laws of gravitation so far as walking on smooth, upright surfaces, or on the ceiling, is concerned. In reality, these pads are thickly beset on the lower surface with short hairs, most of which terminate in a minute expansion kept continually moist by an exuding fluid—a sort of perspiration. Take the human hand, moistened by perspiration or other means, and draw it, with slight pressure, first over a piece of glass or other highly polished surface, and then over something that has a rougher surface, such as a planed board, a papered wall, or a velvety fabric, and you will experience much greater adhesion to the smoother objects, and may understand the important part which these moist pads play in the locomotion of the fly; they also act, in part, like the cushions of a cat's paw in protecting and preventing abrasion of the claws, which are very useful on the rougher surfaces, where the pads are less serviceable.

Now, compared with *Musca domestica*, the claws of *Sarcophaga sarraceniæ* are much the longest and strongest, and the pads much the largest, presenting three or four times the surface. These differences are, I think, sufficient to explain the fact that while the common fly walks with slippery and unsteady gait on the smooth pubescence (the retrorse nature of this pubescence sufficiently explaining the downward tendency of the movements), its sarcophagus congener manages to get a more secure footing;

for not only does the latter present a larger adhesive surface, but the longer claws are more likely to reach beyond the pubescence and the bristles, and fasten to the cellular tissue of the leaf beyond.

In answer to the second question, I can only say that there is nothing exceptional in the power of the larva to withstand the solvent quality of the fluid ; it is, on the contrary, in accordance with the facts known of many species of Muscidæ and Estridæ, some of which, like the well-known horse-bot, revel in a bath of chyme, while others are at ease in the intestinal heat of other warm-blooded animals. It is also well known that they will often live for hours in strong liquids, such as alcohol and turpentine.

Conclusion.—To one accustomed to seek the why and wherefore of things, the inquiry very naturally arises as to whether Xanthoptera and Sarcophaga play any necessary or important rôle in the economy of Sarracenia. Speaking of the Sarcophaga larvæ, Mr. Ravenel asks, "May he not do some service to Sarracenia as Pronuba does to Yucca?" And if so, may not all this structure for the destruction of insects be primarily for his benefit? Can he be merely an intruder, sharing the store of provision which the plant, by ingenious contrivance, has secured for itself, or is he a welcome inmate and profitable tenant? Self-fertilisation does not take place in Sarracenia, and the possibility that the bristly Flesh-fly aids in the important, act of pollination lends interest to the facts. No one has witnessed with greater pleasure than myself the impulse which Darwin has of late years given to such inquiries ; but we should be cautious lest the speculative spirit impair our judgments or our ability to read the simple lesson of the facts. My own conclusions summed up are :—

1. There is no reason to doubt, but every reason to believe, since the observations of Dr. Mellichamp, that Sarracenia is a truly insectivorous plant, and that by its secretions and structure it is eminently fitted to capture its prey.

2. That those insects most easily digested (if I may use the term) and most useful to the plant are principally ants and small flies, which are lured to their graves by the honeyed path, and that most of the larger insects, which are not attracted by sweets, get in by accident and fall victims to the peculiar mechanical structure of the pitcher.

3. That the only benefit to the plant is from the liquid manure resulting from the putrescent captured insects.

[Mr. Ravenel, in making a transverse section near the base of the young leaf, noticed large tubular cells passing down through the petiole into the root, and much of the liquid manure may possibly pass through these into the root stalk.]

4. That Sarcophaga is a mere intruder, the larva sponging on and sharing the food obtained by the plant, and the fly attracted thither by the strong odour, as it is to all putrescent animal matter or to other plants, like *Stapelia variegata*, which give forth a similar odour. There is nothing to prove that it has anything to do with pollination, and the only insect that Dr. Mellichamp has observed about the flowers with any frequency, is a Cetoniid beetle, the *Euryomia melancholica*.

5. That Xanthoptera has no other connection with the plant than that of a destroyer, though its greatest injury is done after the leaf has performed its most important functions. Almost every plant has its peculiar insect enemy, and Sarracenia, with all its dangers to insect-life generally, is no exception to the rule.

6. That neither the moth nor the fly have any structure peculiar to them, that enables them to brave the dangers of the plant, beyond what many other allied species possess.

ON EVOLUTION AND ZOOLOGICAL FORMULATION [*]

IN the means which he has at his disposal for expressing the relative values of the facts of his science the chemist has an advantage over the zoologist which cannot be over-estimated. By a chemical rational formula it is possible to express, in a very small compass, facts of composition and decomposition, as well as many of the other relations borne by the constituents of a compound body one to the other.

In zoology formulation has received but little application ; it has been employed to represent dental series and one or two other numerical points only ; the cumbrous method of detailed verbal description being still resorted to in all cases, even when continuous observation has so accumulated facts, that it is almost impossible to retain the grasp of them without some auxiliary appliances. A method of zoological formulation, which, whilst expressing the facts of anatomical structure, attracts the attention to the relative importance of the observed differences, rather than to the details of the differences themselves, is a great desideratum ; and it will be my endeavour on the present occasion to show how such a method can be made to assist in solving a problem so involved as the true affinities of a group of animals whose variable characters are fairly understood.

But the chemist has the atomic theory as a basis whereon to build ; is there any principle in biology so inclusive as to yield a foundation on which to construct the desired system? Until the introduction of the theory of evolution and the doctrine of natural selection there was not. As long as the negative hypothesis of "special creation" held sway, the interest attached to the study of the mutual relations of organised beings was *nil*. No such relation could, in fact, have existed. But now, through the insight into nature arrived at by the all-embracing theories of Lamarck and Darwin—the Daltons of biology—the pedigree of the animal and vegetable kingdoms will form a problem which it will require many generations of the ablest zoologists to solve, even approximately, by the careful correlation of the undigested, unrecorded, and unobserved facts at their disposal.

Let us stop for a moment to glance at this doctrine of descent, in which, through the struggle for existence, by a process of natural selection, the fittest (for want of a better term) are said to survive. We may compare the living body of one of the higher animals to a cannon counterpoised on a Palliser gun-carriage, so fixed that it will hit a target situated at 1,000 yards distance. Before firing let marks be so made that the different parts of the whole engine can be afterwards adjusted to their former position. The gun is fired ; the target is struck ; a well-defined perforation or indentation is the result. A second similar shot is arranged for, by re-adjusting the engine with the assistance of the marks previously made ; but on this occasion no direct aim is taken. The gun is again fired ; but this time the target is missed, or it is hit in a different part. Why is this? It is because, in the former of the two firings, by the strain it caused to the whole machine, by the wear it produced in the rifling of the gun, and by the slight differences in the quality and quantity of the powder, the shot left the muzzle under different circumstances on the two occasions. The amount of this difference was sufficient, at the long range selected for illustration, to make the alteration in the course taken by the projectile perceptible. An external influence, the wind, is almost certain to have affected the result. This example shows how that minute differences, firstly in internal, and secondly in external circumstances, are sure to prevent the exact accordance of consecutive phenomena which might reasonably have been expected to be fac-similes one of the other.

As a general inference from every-day observation we are similarly led to expect that the offspring of living organisms will resemble their parent forms. But, as with the cannon, there are minor forces which in living beings come into play to produce slight changes in the progeny on all occasions. These changes are likewise of two kinds, depending on the circumstances connected with the parents themselves, and on those acting directly on the offspring from the time of its conception onwards. Amongst the former of these may be included differences in the actual and relative ages of the parents, both of which factors vary with each one of their progeny; their states of health, and their occupations. Amongst the latter are the habits and climate to which the offspring is subject. Causes of this nature, many of which are very incompletely understood, produce variations in the individuals of a species; and as the offspring resembles its parents, unless extra forces come into play to produce differences, the peculiarities of each variety are capable of transmission to the progeny. Thus, in course of time, strongly marked varieties of a species are likely to be developed; these give rise to others, until the descendants are very different from their ancestral forms. Time, however, besides continuing on the primitive stock and developing new varieties, produces other effects with equal certainty. Animals are dependent for their existence on a certain supply of organised food. Those living forms which furnish it have also been affected in a manner similar to their destroyers; like them, they have varied, and they have tended to become more numerous (the progeny in all cases being more numerous than the parents). The area of occupation being necessarily limited, and, as we are justified in assuming, fully stocked to commence with, the multiplication of the progeny develops a universal struggle for existence, one in which each individual, for self-preservation sake, participates; and in which the weakest goes to the wall. As in other contests, however, so in this, the race is not always to the swift, nor the battle to the strong, for many of the destroying causes are not those which are overt in their attacks. The sickly blade of grass, under the shelter of an overshadowing stone, protected from the browsing herd, fructifies and reproduces itself, whilst its free-growing neighbours form a delicious mouthful for the nibbling sheep. What amount of strength or courage can protect the leader of a flock from the ravages of an intestinal parasite? or prevent the largest individual of a flight of birds from being the most likely, on account of its greater superficial area, to be killed by a random gun-shot? Specialisation of function to resist special attack or to acquire special advantage, is, therefore, on account of the struggle for existence in conjunction with the tendency to vary, a factor of vitality. Specialisation in many directions is elaboration and progress so called; and as man possesses this in the most marked degree, he is considered to be the furthest removed from the living monad which gave him origin.

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[*] The substance of a lecture, introductory to the evening class of Zoology, at King's College, Strand. By Prof. A. H. Garrod, Fellow of St. John's College, Cambridge.

The pedigree of vitality is evidently, therefore, the greatest problem of biology; for a full comprehension of it includes all the minor details of the science. How is this to be arrived at? From any collection of people which comprises nearly all the living representatives of a family, it is not difficult to obtain a large amount of information with regard to the ancestry of that family by oral interrogation. This will be facilitated by classing together in groups those of equal kinship, placing in the same sections brothers and sisters, in larger divisions those who are first cousins, and so on. It will not be hard to find who were the grandparents of each, some probably being present; the great-grandparents of most will have only been personally known to the older; and more distant relations of the same line, by hearsay alone. Pursuing the investigation, the linking of each retrograde step will be found more difficult, and the difficulty of identifying the ancestor common to them all will be almost insurpassable. When an old family has very few living representatives or none at all, the facilities for studying it will be proportionately diminished.

In zoology the method of investigation for the purpose of classification is very similar. Instead of direct interrogation, answers are arrived at by an appeal to facts of existing structure. Similarity in habits, distribution, and external characters separate off closely related forms from their more distant allies. To solve the more difficult problems of less intimate relationships, recourse must be had to internal characters in addition; to points of difference in osteological and soft-part anatomy, many of which can only be arrived at by prolonged dissection and the employment of every available opportunity.

The difficulty of appreciating the relative value of differences in any group of animals that is forming the subject of investigation, that of separating the realisation of the characters themselves, independently from the words necessary to express them, has led me in the course of my dissections to adopt a method of formulating my results in a manner which at once places them in a form available for ready comparison, and in an order of relative significance; in fact as rational formulæ, which differ in arrangement according to the phases of my general ideas. An example of the application and the applicability of this method may not be without interest, and this I will draw from the sub-order Psittaci, the Parrots.

The parrots form a well-marked, easily distinguishable group, with no outlying doubtful genera; and as with many other well-marked groups, such as the Rodents amongst mammals, and the Umbelliferæ amongst phanerogamic plants, the minor divisions are not so easily determinable. In fact, there is a very great uniformity in all the external and internal characters throughout the sub-order. There are, however, a few points in which they present variations, those best known being (1) in the vessels of the neck, (2) in the ambiens muscle, (3) in the furcula, and (4) in the oil-gland. I will notice each of these points shortly.

Firstly, with regard to the vessels of the neck. In most of the higher animals an artery, the carotid, runs up each side of the neck to supply blood from the heart to the head. In birds these vessels generally run in the middle line of the front of the neck, side by side and in contact. In some parrots, and in them only, whilst the right carotid pursues its usual course, the left, leaving its fellows, runs separately at the side along with the left pneumogastric nerve. In several groups of birds the right carotid is absent, the left alone remaining in its normal position. This is the case with one genus of parrots. Secondly, the little long and slender muscle, the ambiens, whose tendon in its unique course obliquely traverses the front of the knee capsule, is absent in some parrots, being present in others. Thirdly, the furcula or merrythought, which unites the two shoulders by an osseous bow, may be present or absent. Fourthly, the oil-gland, situated just over the tail, is wanting in some genera.

Omitting for the time being the case, which amongst the parrots is found only in the genus Cacatua proper, in which the left carotid alone is present, there are sixteen possible combinations of the four characters under consideration, of which six are found to exist. They are the following:—

1. The carotids are normal; the ambiens is absent; the furcula is present, as is also the oil-gland.—(PALÆORNITHINÆ.)
2. The carotids are normal; the ambiens is absent, as is the furcula, and the oil-gland is present.—(STRINGOPINÆ.)
3. The carotids run abnormally; the ambiens is present, as is the furcula and the oil-gland.—(ARINÆ.)
4. The carotids run abnormally; the ambiens is absent; the furcula and the oil-gland are present.—(PYHRRURINÆ)
5. The carotids run abnormally; the ambiens is absent, as is the furcula; the oil-gland is present.—(PLATYCERCINÆ.)
6. The carotids run abnormally; the ambiens is absent; the furcula is present; the oil-gland is absent.—(CHRYSOTINÆ.)

The facility for comparison afforded by a formulation of these results will be evident from an inspection of the following Table, in which the presence or absence of structures is represented by the signs + or −; in which the normal condition of the carotid arteries is indicated

by a Roman 2, whilst its abnormal state is indicated by the same figure in italics. The relative positions of the four different anatomical facts is retained throughout :—

TABLE I.

	Carotids.	Ambiens.	Furcula.	Oil-gland
(1) PALÆORNITHINÆ .	2	−	+	+
(2) STRINGOPINÆ . .	2	−	−	+
(3) ARINÆ	*2*	+	+	+
(4) PYRRHURINÆ . .	*2*	−	+	+
(5) PLATYCERINÆ . .	*2*	−	−	+
(6) CHRYSOTINÆ . .	*2*	−	+	−

On this arrangement, the Lories, belonging to the *Palæornithinæ*, their zoological formula is 2 − + + ; whilst that of *Cyanorhamphus*, which is one of the *Platycercinæ*, is *2* − − +. By this means the relations of the different groups to one another are readily recognisable.

Next, in the attempt to arrive at a correct detailed classification, the question as to the zoological formula of the ancestral Psittacine form must be one of primary importance. This can only be arrived at by a comparison of the other bird-types with that of the parrots. Taking the characters employed in Table I., and similarly formulating such birds as the fowl, duck, rail, stork, and cuckoo, they all agree in being represented by 2 + + + (1); others, like the kingfishers and hornbills, have the formula 2 − + + (2); whilst a third type, with only a left carotid, are included in the L − + + type (3). No others of importance exist. From which of them did that of the Psittaci spring? It must have been from one; and, peculiarly enough, there are genera to be found among them which closely approach all three, for—

The formula of *Pittacus* is *2* + + +
„ „ *Palæornis* „ 2 − + +
„ „ *Cacatua* „ L − + +

However, this only shows that the sub-order is a very ancient one, and has undergone changes analogous to the whole class *Aves*, and it does not complicate the problem in the least.

There are parrots with two normal carotids, *e.g.* the *Palæornithinæ*; there are others in which the ambiens is present, *e.g.* the *Arinæ*; most have a furcula and also an oil-gland.

Now suppose that when steam-engines were first introduced they had all been constructed with steam-whistles attached. Suppose that shortly afterwards several had been exported to different colonies, and that ever afterwards each colony had, with the originals as patterns, gone on constructing them for their own use, improving upon the original design as they thought best. Suppose that by certain individual manufacturers a gong was substituted for the whistle; in others a bell, and in a third no sounding apparatus at all. A traveller going through the different countries at the present time would probably find whistle-engines wherever he went, though in different places gongs or bells will have replaced the whistle. Knowing nothing about the history of the steam-engine, is he not justified in inferring that it was originally constructed with a whistle; for otherwise would it be likely that each colony should have independently employed the same method of signalling, when there were several to be chosen from?

The naturalist, similarly, as an uninitiated looker-on at the contrivances of nature, finds the same type of structure running through forms not very intimately allied; as, for example, two symmetrical carotids, in reptiles, mammals, and some birds; or an ambiens muscle in the fowl, the eagle, the cuckoo, and the plantain-cutter. When, therefore, these fundamental arrangements are found to exist (though perhaps not combined in any one individual) in any well-defined group like the parrots, may it not be legitimately inferred that the ancestor of that group possessed them in their full and unmodified form? Undoubtedly it may; and on this principle we can almost certainly assume that the ancestral parrot possessed two normal carotids, an ambiens muscle, a complete furcula, and an oil-gland; in fact, that its formula was 2 + + +; and that all those species in which one or other of the included characters differ from this *type formula*, they do so on account of forces having modified the ancestral form. This line of argument therefore leads us to infer the extinction of the earliest form of parrot, unless some yet undissected genus is subsequently found to correspond with it; and all the existing genera must be referred to collateral branches, in which at least one operation of modification has been accomplished. Those which have undergone no further change from the 2 + + + type are the *Palæornithinæ* (2 − + +), and the *Arinæ* (*2* + + +). Now the question presents itself, are all those with the modified carotid (*2*), members of a single stem, and those with the unmodified carotid (2) members of another, similar losses having occurred in both to develop the subjoined series?

TABLE II.

2 − + +	*2* + + +
2 − − +	*2* − + +
L − + −	*2* − − +
	2 − + −

Or must those types be blended in which the formulæ correspond, irrespective of the carotids? My placing the carotid index first expresses my belief as to its primary importance; and this is because the conformation it represents is extremely peculiar and unique among birds, and is therefore less likely to have appeared except as the operation of a specially applied force on a single collection of individuals, the power of transmission being inherited. From this it may be inferred that the ancestral unmodified stem shortly sent off a branch represented by *2* + + +, which persists as such in the *Arinæ*. The main stem and its branch must each have, before long, had a branch of its own, represented by 2 − + + and *2* − + +, which persist as the *Palæornithinæ* and the *Pyrrhurinæ*. From the 2 − + + division sprang the 2 − − + (*Stringopinæ*), and the genus *Cacatua* (L − + −), as did the *2* − − + (*Platycercinæ*) and the *2* − + − (*Chrysotinæ*) from the *2* − + + division. The genus Cacatua is peculiar in having only the left carotid running normally, it must therefore be connected with the normal 2 carotid stem, and many Cacatinnæ, like the Cockateel and the Banksian Cockatoo, are represented by the formula 2 − + +. Some of the true Cockatoos, and some only, have no oil-gland.

My object in giving this somewhat lengthy illustration on the present occasion is to show how much facility a method of formulation affords in the working out of a minor problem of the great doctrine of heredity, such as the classification of the parrots. It makes comparison easy, it facilitates the performance of operations of addition and subtraction, bringing all the stages of the process before the mind's eye without any mental effort. Is it not one to be further developed?

THE OPTICS OF THE SPECTROSCOPE

NOW that the Spectroscope is becoming an instrument of world-wide use, we think it will be not uninteresting to call attention to some few points that appear to be often overlooked in designing the instrument for various purposes; and in order to ascertain the best arrangement, we cannot do better than analyse the effects produced in any spectroscope by varying the proportion of its parts. We must, however, premise by saying that the power of an instrument is not altogether dependent on the dispersive power of the prisms, but also on the width of the image of the slit in the eyepiece of the telescope of the spectroscope. To make our meaning clear, let us suppose that the slit is illuminated with a sodium flame, then the dispersive power of the prisms will produce in front of the eyepiece two images, or "lines," and with the same lenses the distance of their centres will depend upon the prismatic power; but it is clear that if the slit be widened, the two images will eventually widen until they touch each other or overlap. There is, then, the same dispersion, but less separation, than when we use the narrow slit; and it would follow from this that with an almost indefinitely small slit a prism of very small dispersion would give two separate images of a sodium-illuminated slit, which could be magnified so as to have their distance and width the same as would be given by using a wider slit and greater prismatic dispersion; but with an eyepiece of the large power required, the lines would be so diminished in brightness as to preclude this arrangement; and in order to see a spectrum as brilliant as possible, the eyepiece ought to be as low in power as possible consistent with reducing the cylinder of rays sufficiently small that they all enter the lens of the eye.

Let us now consider a spectroscope of any number of prisms having the focal length of the collimator the same as that of the telescope: then the image of the slit in the focus of the telescope will be of the same size and of the same brightness; for we must, for this consideration, omit the loss of light by reflection and absorption for the present, as the slit itself, which we will first suppose illuminated by sodium light, so that two yellow images of it will be visible in the eyepiece. Afterwards we will consider the case in which sun-light is used. First let us consider the effect of opening the slit wider, say double the width. By this means the images will be doubled in width and the separation diminished; the amount of light will be doubled, but will be spread over double the area, so the intensity of illumination will remain the same; therefore the slit should be as narrow as possible consistent with the image being wide enough to be visible. Secondly, let us double the length of the collimator. By this we halve the width of the image of the slit, so that the separation is increased, but the distance between the centres of the lines remains the same; the angle subtended by the collimating lens will in this case be halved, so that the amount of light passing will only be ¼ of the original amount, but as the image of the slit is reduced in like proportion, the intensity of illumination remains the same; the effect in this case is therefore the same as narrowing the slit, with the exception of the lines being shorter, thereby reducing the width of the spectrum—a matter generally of little moment, which can be altered at ease by lengthening the slit. Thirdly, we will double the diameter of the collimating lens, and with it that of the telescope and the prism. By these alterations the amount of light passing becomes quadrupled, therefore the images of the slit will be four times brighter; but the angle subtended by the telescope lens at the image is doubled, so that in order to get the whole of the light into the eye, the eyepiece must be placed at half its distance from the image, and be consequently doubled in power; the images will by this be reduced to their original brightness, but they will be magnified at the same time, and the distance from centre to centre doubled, the separation doubled, and the width of the images doubled, so that the slit may be reduced in width by ½, and yet leave each image as wide as at first. This will increase the separation between the interior sides of the image still more, so that by doubling the size of our lenses and prisms we have obtained double separation of centres of images, and more than double separation between images, which is just what would be produced by doubling the number or dispersive power of the prisms. It is therefore obvious that in dealing with a bright-line spectrum the power of the instrument depends on the size of the prisms as much as on their number, and an increase in number means an increase in the number of reflecting surfaces and loss of light, so that within practical limits an increase of size is the more preferable. Practically, on increasing the size of the collimating lens, as in this case the focal length should be increased, otherwise the lens is injured in defining power, the effect of this increase is, as shown in the second case, only equivalent to closing the slit, so it is better to lengthen the collimator instead of touching the slit; it is also better to increase the focal length of the telescope glass, thereby straining it less, and so increasing the size of the image of the slit without altering the power of the eyepiece.

Now let us consider the effect of these alterations on sun-light or other light giving a dark-line spectrum; and there is this difference between the consideration of this spectrum and the bright-line spectrum, for in this case the dark lines are not images of the slit, but intervals between them, and therefore their width and appearance depend not so much on the separation between the centres of the bright lines as on the separation of their adjacent sides, and with the same width of any two bright lines this separation or width of dark line does not vary in the same ratio as the distance between the centres of the bright lines, or as what is called the dispersive power, varies, but in a higher ratio. For example: suppose there appear in a spectroscope the two sodium lines of appreciable width with the finest possible dark line between them; then, if the distance of their centres is doubled without increasing their width, the black line becomes increased by the increment of the distance of their centres, and with this increment the original dark line becomes much more than doubled; this will be seen better by drawing two bright lines of appreciable width on paper, and going through the process just mentioned. It is therefore separation, according to our definition of the word, that is required for dark-line spectra.

We will now consider the effect when using sun-light instead of sodium light in a similar manner to our first arrangement, namely, in our normal spectroscope, and let us widen the slit as we did before. Every image of the slit will then widen, and the separation between the sides of any two images will diminish, and therefore the dark lines will diminish in width as they are encroached on by the light on either side; the general spectrum will, however, increase in brilliancy, for although each image is only increased in size, as was the case with sodium light, still the images of each colour overlap, and so produce greater intensity. From this we gather that to obtain the greatest number and width of dark lines, the width should be as narrow as is compatible with sufficient illumination of the spectrum, to show up the dark lines; and so with a dark-line spectrum as with a bright-line one, the slit should be as narrow as possible.

Secondly, as with the sodium light, let us lengthen the collimator, say double it: then, as with the sodium light, the images will be halved and the separation increased, but only ¼ of the light passes, and the spectrum is reduced in width by ½, so that its brilliancy is ½ what it was originally; or we may account for the decrease in brilliancy by considering that although, as we showed in the case of the sodium light, the images of the slit are not reduced in brilliancy, still there is less overlapping and so less brilliancy. So we see that in order to keep a sufficient brightness of spectrum to show the dark lines, we must open our slit if we lengthen our collimator, and *vice versâ*, so that no power is gained by either of these methods, as was the case with the sodium light. Thirdly, we will double the diameter of the collimating lens, and with it that of the prisms and telescope object-glass. By this means the brilliancy only of the spectrum is changed, and this is quadrupled in the focus of the eyepiece, but the focal length must be halved in order to reduce the cylinder of rays small enough to totally enter the eye: this will magnify the spectrum to double its original size in every direction, and so double the width of the dark lines, but will produce no new ones; it will also reduce the brightness of the spectrum to its original state. Now, when we were dealing with sodium light, we at this stage of proceeding halved the width of the slit, for the images of the slit had been doubled without their brightness being reduced, so we could halve them and bring them to their original size, and so increase the distance of separation still more; but with a continuous spectrum, if we close the slit we shall, it is true, only decrease the width of each image of the slit and not their brightness, but we decrease their overlapping and so decrease the brilliancy of the whole spectrum, and this we cannot afford to do, as we have started with as narrow a slit as possible, and consequently with as small a brilliancy as possible consistent with showing the dark lines. We have therefore by this alteration of size of glasses doubled the width of dark lines originally visible, but we are not able to more than double the separation of any two images of the slit, as we did with the sodium light images, by narrowing the slit in addition to increasing the distance of the centres, and therefore no new lines are produced; in fact, the result of our change of arrangement has been the same as a simple magnification of the spectrum without a decrease in brilliancy; and an increase of prismatic power is exactly similar in effect, as we shall presently show, though it seems at first untrue that increase of prismatic power will not increase the number of dark lines visible. Let us now double the number of prisms; then the length of the spectrum will be doubled, and the distance of the centre of the images of the slit doubled, and therefore more dark lines may appear in addition to the original ones being widened, but the brilliancy of the spectrum has been halved, and in order to brighten the spectrum to the original state the width of the slit must be doubled, which exactly undoes all that the extra prisms have done in producing more lines; for the images will expand and obliterate the newly-formed lines; the original dark lines will, however, after the widening of the slit, be double their original width; so that, as we have just stated, the increase of prismatic power will not make a greater number of dark lines visible. If we illuminate the slit more intensely, we may decrease the width of the slit and still retain our original brightness, and so obtain a reduction in the width of the images, and consequently a greater separation between their edges, and therefore an increase in the number of dark lines in addition to increase of width of those originally visible; so that for the same kind of light the number of dark lines depends on the intensity of the illumination of the slit.

In dealing with the spectrum of an intense light like that of the sun, where there are a large number of lines, it is necessary to use an instrument of high power, whether in number or size of prisms, in order that the exceedingly fine dark lines produced by a low power may be, as it were, magnified without loss of light, which is, as we have shown, the effect of an increase of prismatic power; and in order that these fine lines may become visible and sufficiently separated to render their identity for measurement or otherwise complete, so there may be an apparent increase in the number of lines by the invisible ones being rendered visible by magnification without loss of brilliancy in the spectrum.

But in dealing with light like that from a planet or the moon, where the slit must be so wide that few lines are visible, it can soon be tested in practice that the increase of power does not increase the number of lines. In examining the light of the moon or of a nebula, or any object having an appreciable diameter, any increase of telescopic power for the purpose of forming the image on the slit will not increase the useful brightness of the slit; for, supposing a spectroscope be working to its greatest advantage on a telescope, then, if the diameter of the object-glass of the telescope be doubled, the angle it subtends at the slit will be doubled, and the cone of rays on the collimator side of the slit will have its base doubled, and therefore it cannot all pass through the collimating lens; in fact, all the rays newly added by the increase of diameter of object-glass will be wasted against the tube of the collimator, and if we try to utilise these rays by increasing the size of collimating lens or decreasing its focal length, we shall also have to increase the power of the eyepiece to get all the rays into the eye, and so reduce the brilliancy of the spectrum to its original state. In the case of increasing the focal length of a telescope as well as its aperture, the brightness of the image on the slit is not increased, but only its size; so the spectroscope is unaffected. But in the case of viewing the spectrum of a star, matters are altered, for the image of the star does not increase in size by increasing the focal length of the telescope together with its apertures; but its brilliancy is increased, and therefore greater prismatic power can be used without increase of width of slit, and more dark lines seen; so that for stellar spectroscopy an increase of telescopic apertures is a direct advantage. From the foregoing remarks we gain that in the construction of a spectroscope the eyepiece should be of as long a focus as possible, so as just to cause all the rays to enter the eye; all magnification beyond this means loss of brilliancy, and if the spectrum appears insufficiently large an increase in size of the collimating and telescope lenses, together with the prisms, or an increase in the number of the prisms should be made, until the spectrum appears sufficiently large to suit the requirements of the observer. G. M. S.

THE SUB-WEALDEN EXPLORATION

THE Secretary of the Sub-Wealden Exploration has just issued his eighth quarterly report, in which he states that but little progress has been made during the last three months in consequence of the inability to procure lining tubes of the required size in sufficient quantity. The increased favour in which the diamond boring system is now held has caused a great demand for these tubes, and they are specially manufactured by an eminent Birmingham firm. The new pipes are required for the difficult process of enlarging and lining the bore-hole to the diameter considered requisite before attempting to withdraw the broken rods, &c. Mr. Willett says:

"The engineers have no doubt whatever of their ultimate success, and as the extraction of the rods is not a matter involving the expenditure of our funds, we can only regret the loss of the long summer days, and take comfort from the assurance that, 'after the enlargement and lining is accomplished, there is a much better prospect of obtaining the desired depth of 2,000 ft. than there was a year ago that we should reach half the distance (1,000 ft.), provided always that the *requisite funds be forthcoming*.'"

He is anxious to dispel what he terms "the delusion" that no more money is required from the public in consequence of a Government grant to the work having been obtained. He states that the Chancellor of the Exchequer, with laudable foresight and prudence, has promised to assist on certain conditions, to do which—

"I. We must spend 400*l*. in boring tubes, &c.
II. We must bore 100 ft., which will cost 200*l*.; and *then*, and *not till then*,
III. We can draw 100*l*. from the Exchequer, and so on, claiming 100*l*. for every 100 ft. actually explored."

The third and last year of the tenancy for carrying out the work has been entered on, and therefore the necessity of speedily resuming the operations is at once seen. The financial position is cheering, the present balance being 594*l*. 7*s*. 9*d*. The honorary secretary says:—

"We are greatly indebted to the Right Hon. the Chancellor of the Exchequer, and to the Secretary of the Treasury (by whom the deputation was introduced), for having favoured us with an interview and patiently listened to our appeal for Government aid.

"The grounds of our claim were stated in our last report, and were naturally met by the remark that 'it would be a dangerous precedent to apply national funds for private purposes.' If all future applicants be compelled to

I. Raise 3,000*l.* by subscription;
II. Bore 1,000 feet; and
III. Obtain a memorial from the Royal Society, the Geological Society, and the Institute of Civil Engineers, stating that the prosecution of the work is of national importance;

they are not likely to be troublesome by their numbers, and the subject having been ventilated in the House of Commons, few reasonable minds will be disposed to doubt the discretionary wisdom of the grant with its attendant conditions.

"We are much indebted to William Topley, Esq., F.G.S., for having consented to visit Belfast, there to read our report and make personal application for additional aid from the Committee of Recommendation of the British Association for the Advancement of Science, and we are greatly encouraged by the response and the grant of 100*l.*

"The kind promise of Sir Charles Blunt to give us 50*l.* on reaching 1,000 ft. has been faithfully performed; so also will Mr. Warner's promise of 300*l.* when we reach 2,000 ft.

"In scientific research it has often occurred that the benefits accruing have been indirect and unexpected by the promoters. Not only have the rich beds of gypsum been made known, and, in consequence, are now in actual process of development, but the new facts ascertained by our work have thrown some considerable light (and that of an encouraging nature) on the problem of the feasibility of constructing a sub-marine tunnel between England and France.

"The motives which actuate our friends to subscribe are various and sometimes novel, as, for instance, one writes: 'I enclose my mite—besides the objects stated, a shaft is doubtless a safety valve against earthquakes.'"

The report concludes by thanking the directors of the London, Brighton, and South Coast, and the South Eastern Railways, for their assistance in the work, the latter company having, in addition to granting other privileges, in the use of their line, forwarded a cheque for 50*l.* The kindness of the Earl of Ashburnham, the Rev. T. Partington, and many others is acknowledged, and the honorary secretary concludes his report with an earnest hope for further encouragement, and that the results will prove that their labour has not been expended in vain.

NOTES

THE inhabitants of a vast district of London have had during the past week an opportunity of studying the phenomena of explosions on a large scale, and of noticing how closely they approach those of earthquakes in the sequence of long-rolling waves of the solid earth, loud noises, and finally long continued tremulous motion and more subdued sounds. If we could have announced last week that 100 barrels of gunpowder would explode in London, locality not defined, on a given day, the inhabitants would probably have been alarmed, many would certainly have visited their country friends; but our Government have for years been warned that such an occurrence might happen seeing that there is no legislative enactment to ensure care, and yet they have let such a state of things continue! We have it on the authority of the *Times* that the *Tilbury* might have had 500 barrels on board instead of 100, and it is clear that these might have exploded in a locality where the consequent destruction of life and property would be fearful to contemplate. It appears that, bad as are the regulations for the transport of gunpowder on board ship, there is little or no provision for the prevention of accidents at places where powder is received and delivered in large quantities. In reporting on this branch of the subject in 1865, Major-General Boxer instanced the case of Isleworth. He says:—"The powder wharf at Isleworth affords a good illustration. This wharf is situated in the town of Isleworth, on the banks of the Thames; on an average as much as 600 barrels per week is shipped there, the wharf is surrounded by houses, and the sacrifice of life would be fearful in the event of an explosion." Major Majendie, in a report to Government two years ago, wrote:—"I am quite sure that if the public were at all aware of the extent to which gunpowder is handled in large quantities, without any special regulations, in the middle of the metropolis and of large cities, they would be seriously alarmed, and would demand the adoption of measures for removing so patent a danger." Truly we are a practical people, and much superior to the Germans, who only allow the transit of large quantities of gunpowder through populous districts under military escort.

THE effect of the explosion in the Zoological Gardens was not so serious as might have been expected from the proximity of the gardens to the scene of the disaster, but several of the animals were thrown into a state of great agitation. The elands, antelopes, and deer, particularly, were very much startled, and were found running round their enclosures in a state of great alarm. The elephant, hippopotamus and rhinoceros, and the giraffes were very much excited, and the birds became much alarmed. About a dozen of the smaller birds escaped through a hole in the glass roofs of the aviary, caused by the concussion, but two or three returned during the day. The blankets and coverings were shaken off the snakes, but fortunately none of the glass in their cages was fractured. It was fortunate, too, that none of the large carnivora were liberated.

WE referred some little time ago to the fact that a sum of about 30,000*l.* had been left to the "London Academy of Sciences." We hear that already several societies and institutions have sent in, or are thinking of sending in, claims. It is stated, however, that the Royal Society, which certainly is the nearest approach to the institution in Signor Ponti's mind, has not applied. The Royal Society is of course a mere private body, and might well be held to be justified in refusing to incur the responsibility of distributing a large sum for the furtherance of science; but the miserable chaos in our scientific arrangements is none the less strongly brought out by the present juncture. In England, truly, Science is a body without a head!

FRANCE, Germany, and Austria are vying with each other in astronomical activity. In the grounds of the Paris Observatory a 4-ft. Foucault mirror is being erected, and M. Le Verrier has already obtained a grant for a 30-in. refractor. The Vienna Observatory is also making arrangements for the reception of a telescope of similar aperture. Messrs. Merz have nearly completed a lens of 20 in. aperture, for the University of Strassburg. In France, the newly-created *Ecole Speciale des Hautes Etudes* is being taken advantage of to form a school of Astronomy; in Germany and America many such schools exist already, thanks to the rational administration of their Observatories, the assistants in which are the pupils, friends, and potential successors of the director.

M. DESJARDINS, one of the head officials in the Ministry of Public Instruction, has been ordered by the Minister to inspect the meteorological service of the Observatory and to report upon its present condition.

THE Government of Newfoundland has determined to take steps for the protection of the seal fisheries, by preventing vessels from leaving port before a certain date, and are anxious to induce the Governments of other countries, whose subjects are engaged in other fishings, to take similar measures in respect to vessels leaving their respective ports. It is hoped thereby to establish an international convention, which will have the effect of giving the seals at least another month after the breeding season, in which the young may increase in size and value, and thus the fearful slaughter of immature seals which has threatened the total extermination of the animal will be checked.

THE ordinary business of the Paris Academy of Science was entirely suspended at the meeting on September 28, owing to the death of M. Elie de Beaumont. The burial took place on the 25th, the entire Academy attending their *confrère* to the grave. Funeral addresses were delivered by M. Dumas on behalf of the Academy, by M. Ch. Sainte-Claire Deville on behalf of the Mineralogical Section, by M. Daubree in the name of the School of Mines, and by M. Laboulaye in the name of the French College.

THE President and Council of the Royal Society of Edinburgh, "impressed with the conviction that the progress of the sciences demands, and has long demanded, fuller and more exact tables of logarithms than any which at present exist," have memorialised Sir Stafford Northcote with the view of inducing the Government to print a nine-figure table of logarithms of numbers from unity to a million, part of which has been already calculated by Mr. Sang, who has carried a fifteen-figure table up to 300,000. The subject of undertaking the publication of logarithm tables—so long as the number of figures does not exceed ten, the limit of utility—is one well worthy the attention of the Government; but in the present case there are several reasons why, if the application is refused, the loss to science will not be so great as some might think. In the first place, a table of 1,800 large pages, whether in one, two, or three volumes, will be so unwieldy that, notwithstanding the ease of the interpolations, it would probably be very seldom used by computers; and secondly, because all who require more than seven figures will, no doubt, prefer to use ten, and consult the existing works. In fact, nearly all computers would, we believe, employ Vlacq or Vega in preference to the proposed table. Mr. Sang, in the pamphlet which accompanies the memorial, makes a remarkable error when he intimates that the great French tables have not been used to verify any seven-figure table, so that "up to the present moment we have no verification of Vlacq's great work." In point of fact, the whole of Vlacq was read with the copy of the French tables at the Paris Observatory, by M. Lefort, and the results of the comparison are published in vol. iv. of the "Annales de l'observatoire de Paris." Almost all the errors found by Mr. Sang by means of this table are among those there given by Lefort, and anyone who chooses can, without much expenditure of trouble, render his copy of Vlacq all but free from error—much more accurate than any new table could possibly be.

ATTENTION is being again directed to the cultivation of Cinchonas in St. Helena, which at one time promised so well, but which has, owing to changes in the Government, been allowed to lapse into decay. Some seven or eight years since, when the island was under the governorship of Sir Charles Elliott, Dr. Hooker strongly advised a trial of the plants to be made, and plantations were formed at Diana's Peak. So satisfactory was the progress of the plants that the Government consented to the selection of a gardener from amongst the best or most intelligent of those to be obtained at Kew. One was chosen and sent out, and, to quote from a recent number of the *St. Helena Guardian*, "All went well so long as Sir Charles Elliott was at the head of affairs: plantations were formed, and the gardener, Mr. Chalmers, was treated as one having the charge and responsibility of an important colonial experiment, and the plants grew well up to the time when Sir Charles Elliott left and Admiral Patey was appointed in his stead. The new governor at once decreed that the plantations at Diana's Peak were a mere foolish waste of money, that the gardener sent out from Kew would be better employed at Plantation House, and employed he was, chopping firewood and raising beans, peas, and radishes, and selling them for the benefit of the privy purse of Government House, and the Cinchona plantations were left to go to ruin or to flourish by their own unaided vigour, as the case might be." The result of three years' cultivation and three years' subsequent neglect seems to be, that although there are a few dead and sickly plants, nearly all the trees are in full vigour and luxuriant growth. There are about 300 flourishing plants, many of which are twelve feet high, and three to four feet in diameter. The bark is also a quarter of an inch thick, and has an intensely bitter quinine taste. Many of the plants in the St. Helena plantations have the lower part of their stems bound up with moss in order to try if the bark would not swell and increase more rapidly, but it has had the effect of showing, by the bursting out of rootlets from the part so bound with damp moss, that the plant throws forth roots readily from the bark, and thus may be easily propagated by cuttings. The Government has recently been again in correspondence with Dr. Hooker on this subject, and it is to be hoped that the cultivation will be again renewed and prosecuted continuously.

WE have been requested to publish the following extract of a letter recently received from Cambridge (Mass.):—"We have been very much amused by the pertinacity with which our friends on your side are determined to provide us with a successor to Prof. Agassiz, to fill a vacancy which has no existence and has been filled long since. Alex. Agassiz takes his father's place in the Museum, assisted by Count Pourtales and Col. Lyman, who attend more to the details; and the professorship has been divided, and separate professors appointed, one for zoology and one for geology. There is now therefore no vacant chair in Harvard, so far as I know, although Prof. Wyman is lately deceased; but I think he relinquished his duties some time since, on account of ill health. So I do not perceive the slightest chance for the numerous successors proposed in England or elsewhere."

THE French Geographical Society sent a deputation to Vienna to offer its official congratulations to the Hungro-Austrian Polar Expedition. It was very cordially reciprocated by Payer and his associates.

AN International Horticultural Exhibition will take place at Antwerp, commencing on April 4, 1875, under the auspices of the Royal Society of Horticulture and Agriculture of that town, and promises to be on a large scale. An International Exhibition of Fruits will also be held at Amsterdam in October 1875, under the management of an influential committee.

WE learn from the *Belgique Horticole* that that cryptogamic pest the *Puccinia malvacearum* is making sad havoc among the mallows and hollyhocks in some parts of Belgium.

WE are informed that the *Phylloxera* has appeared in Switzerland, and that the delegates of the wine-growing cantons met on Monday last, the 5th inst., to consider the best means of preventing its extension.

SOME excitement has been aroused in New York by the discovery of a rich vein of hæmatite iron ore in the heart of the city by some workmen who were digging foundations for a new building. The vein, which is 30 ft. wide, was found at a depth of only 4 ft. from the surface.

PROF. BENTLEY and Mr. Trimen are engaged in the production of a voluminous work on the medicinal plants of the world.

As there are not many works devoted to this important branch of botanical science, we shall gladly welcome this book, as from the well-known abilities of the authors we have every reason to anticipate that it will at once take a prominent position among standard works on this subject. It will be copiously illustrated.

DR. HUMPHREY, F.R.S., the Professor of Anatomy at the University of Cambridge, gives notice that his course of lectures on Practical Anatomy will begin on Thursday, Oct. 8, at 9 A.M., and be continued daily. The course on Anatomy and Physiology will commence on Friday, Oct. 23, at 1 P.M., and be continued on Tuesdays, Thursdays, and Saturdays, at the same hour. This course is intended for students of natural science as well as for students of medicine, and gentlemen not requiring certificates are at liberty to attend without fee.

A TELEGRAM received at Hull from the captain of the schooner *Samson*, which has just returned from a cruise in the Arctic regions, announces the discovery of large beds of coal at Spitzbergen.

THE volcanic soil in the neighbourhood of Vesuvius is stated to be an antidote to the potato disease and other fungoid diseases of plants. It is also said that it is found of great value in the treatment of *Phylloxera*; this, however, remains to be proved.

THE inaugural meeting of teachers, students, and friends of the College for Men and Women (with which is incorporated the Working Women's College) will be held at St. George's Hall, Langham Place, on Monday, October 12. The chair will be taken by Mr. Thomas Hughes, Q.C., at 8 P.M. The College is established to afford to men and women occupied during the day a higher education than has generally been within their reach. The classes are taught for the most part gratuitously, and the design is that mutual help and fellowship may be promoted between all members of the College, teachers and students, by the educational work in the classes and the social life of the coffee-room.

THE Statistical Society, that has occupied apartments at No. 12, St. James's Square, for nearly thirty years, as a tenant of the London Library, has recently changed its quarters to the house formerly occupied by the Principal of King's College, and its present address is Somerset House Terrace, Strand, W.C., London (King's College entrance). This change has become necessary by the simultaneous growth and development of both the London Library and the Statistical Society, and is therefore a matter of congratulation to both institutions.

WE have to record the death, on Saturday last, of Dr. William W. Fisher, Downing Professor of Medicine in the University of Cambridge since 1841, when he succeeded Dr. Cornwallis Hewett. Dr. Fisher, from being an undergraduate, first at Trinity and then at Downing College, became Fellow of the latter, and remained so until he accepted his Professorship. He was formerly physician to Addenbrooke's Hospital, and till his death steward and librarian of his College. The stipend of the Professorship is 400*l.* a year with a residence in Downing College; it must be refilled within two months of a vacancy occurring.

THE opening meeting of the approaching session of the Medical Microscopical Society will take place at the Royal Westminster Ophthalmic Hospital on Friday, the 16th inst., at 8 P.M.

ALPHONSE DE CANDOLLE, of Geneva, whose first botanical memoir was published forty-five years ago, has been elected one of the eight foreign associates of the Academy of Sciences at Paris, in the place of Agassiz.

M. MELSENS, a member of the Royal Academy of Belgium, has published a pamphlet describing the verification of lightning-conductors, as practised by him in several monuments of Brussels, for ascertaining if they are in a position to conduct electricity into the humid parts of the earth. The experiments were tried with a Hely machine, and with Daniel elements and galvanometers. In the first instance fifteen of the pupils of the Veterinary School were employed to ascertain if they had received any shock.

THE reptiles of the French Museum have been removed to their new home. The boas had been previously overfed, so that they were as easy to handle by the keepers as so many cables. The crocodiles were most unmanageable, and it was necessary to use nets in order to catch them. Some of the venomous snakes were tempted by food offered to them into small cages, in which they were shut up hurriedly, and removed. Now everything is right, and the several inhabitants of the reptile menagerie are happy and contented in the new building which will be formally opened within a few days by the Minister of Public Instruction.

THE death is announced of one of the most prominent and indefatigable members of Col. Gordon's expedition, Mr. Anson, who succumbed to an attack of fever on the 27th of July. The deceased was the son of Admiral Anson, and was highly esteemed by Col. Gordon for his zeal and usefulness.

M. X. DUCLOUX has discovered and given the name of *Rivotita*, or Rivotite (in honour of the memory of M. Rivot, late Professor of the School of Mines, at, Paris), to a new kind of mineral, which is found in small irregular masses, dispersed in a yellowish-white chalk, upon the western slope of the Sierra del Cadi, in the Spanish province of Lerida.

WE have received the Sixth Annual Report of the Cardiff Naturalists' Society, and are pleased to notice that the year just closed has proved most successful; the number of members has increased from 190 to 288, and the finances of the society are in a good condition. During the past year, the committee have organised for the first time a series of scientific and literary lectures, which have been largely successful.

THE additions to the Zoological Society's Gardens during the past week include two Call Ducks (*Anas boschas*), European, presented by Mrs. Wilson; four Little Bustards (*Tetrax campestris*), European, purchased; a Rhesus Monkey (*Macacus erythraeus*) from India; a Solitary Tinamon (*Tinamus solitarius*) from South America; three Lesser Pin-tailed Sand Grouse (*Pterocles exustus*) from North Africa; two Cornish Choughs (*Fregilus graculus*), European, deposited.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for August contains, in addition to the usual abstracts from foreign journals, the following papers communicated to the Society:—On ipomœic acid, by E. Neison and James Bayne. This acid, obtained by the action of nitric acid upon jalapin, has been shown by the authors to be identical with sebacic acid. This conclusion has been arrived at from a comparison of the solubility, melting-point, and composition of the acids. The potassium, barium (normal and acid), lead, and silver salts have been prepared and examined.—Note on New Zealand kauri gum, by M.M. Pattison Muir. The gum is an exudation from a coniferous tree (*Dammara Australis*) imported into this country for the purpose of making varnish. The action of different solvents and of various reagents has been tried, from which it appears that the substance is a mixture of resins with a true gum, and is therefore to be classed as a gum-resin.—On certain compounds of albumin with the acids, by George Stillingfleet Johnson. Compounds with nitric, hydrochloric, sulphuric, orthophosphoric, metaphosphoric, citric, oxalic, tartaric, and acetic acids have been obtained. The method of preparation consists in dialysing white of egg over dilute solutions of the acids. The action of water heated above its boiling point upon these compounds has been studied, and special experiments undertaken to ascertain the nature of the action exerted by the dialyser in producing the compounds. The author concludes that the following points have been probably established by his experiments:—(1) The existence of definite compounds of albumin with the acids in simple molecular ratios (the probable formula of the nitric acid compound may be given by way of illustration—$C_{72}H_{112}N_{18}SO_{22}2HNO_3$). (2) The applicability of dialysis to the ready and accurate preparation of these compounds. (3) Probable correctness of the formula of Lieberkühn, Loew, and Liebig for albumin.—On a simple method of estimating urea in urine, by Dr. W. J. Russell and S. H. West. The authors make use of the well-known action of hypochlorites and hypobromites upon urea:—

$$CO(NH_2)_2 + 3HClO = CO_2 + 3HCl + 2H_2O + N_2.$$

The most advantageous solution for this purpose is formed by dissolving 100 grms. of caustic soda in 250 c.c. of water, and adding 25 c.c. of bromine. A measured quantity of urine is introduced into a bulb-tube of particular form, and then allowed to mix with excess of the hypobromite solution. The reaction is complete in from ten to fifteen minutes in the cold, but on warming is complete in five minutes. The apparatus is so constructed as to permit the collecting of the evolved nitrogen in a tube which is graduated in such a manner that the amount of gas read off gives at once the percentage of urea in the urine employed. A remarkable fact observed by the authors is that in the reaction between urea and the hypobromite there is invariably eight per cent. less nitrogen evolved than that required by theory. With uric acid 35 per cent. of the nitrogen is suppressed, with hippuric acid 82½ per cent., and with creatinine 25 per cent.—The concluding paper is on Dendritic spots in paper, by Huskisson Adrian.

THE *Scottish Naturalist* for October contains the following articles:—On the Salmonidæ of the Eden, Fife, by P. Walker, F.G.S.E.—Notes on the entomology of Shetland, by the Rev. J. Blackburn and C. E. Lilley.—Concerning aquaria, by Dr. Peter White.—Tenthredinidæ in Rannoch, by P. Cameron.—Notes on Lepidoptera in Kirkcudbrightshire, by W. D. Robinson Douglas.—The occurrence of rare birds in the Carse of Gowrie, by Col. Drummond Hay.—Several articles on the fungi of Scotland, and a continuation of the lists of Scottish insects, by F. Buchanan White, M.D., and D. Sharp, M.B.

THE *Bulletin de la Société d'Acclimatation de Paris* for June opens with a paper by M. Ch. le Doux, on the yield of the cocoons of the new silkworm *Attacus aurota*, and on the best mode of winding the cocoons which are pierced by the moth on its escape, or left unfinished by the silkworm.—M. P. Chappellier gives an interesting account of the growth and preparation of saffron, with special reference to the production of new species of crocus and other saffron yielding plants in France.—The East Indian possessions of Holland, Java, Sumatra, Borneo, the Moluccas, and other islands, are the subject of a paper by M. E. Prillieux, who gives a valuable list of their principal productions, industrial and otherwise. This list includes no less than 247 timber-producing plants grown in the East Indies.—Among fishery questions perhaps no subject is of more importance than the effect produced by the use of fixed engines. Contributions to the literature on this point are made by M. Renibaud in a letter addressed to the Minister of Marine, and by Dr. Turrel, delegate of the society at Toulon.—M. Delidon continues his researches on the change of colour in the silk produced by silkworms, caused by a change of food.—M. Kemmerer, the inventor of cemented tiles for catching oyster-spat, announces that he has relinquished his patent rights in the invention which has been so successfully adopted by oyster-culturists.—The Minutes of the monthly meeting of the society, detailing the various experiments made by its members, are very interesting, including observations on many diverse subjects.—The Agricultural Society of France has offered a prize of 1,000 francs each for the best method of artificial irrigation, for the best means of destroying the *Phylloxera vastatrix*, for the best economical means of utilising the beetroot and its products, for the best horse-breeding establishment in Finistère, Côtes-du-Nord, Morbihan, Ille-et-Villaine, and Loire Inférieure, and for the educational establishment which shall have taken the best means to instruct in agriculture and horticulture.

Zeitschrift der Œsterreichischen Gesellschaft für Meteorologie, Sept. 1.—In a former number of this periodical an instrument called the nephoscope was described by Herr Braun, intended to serve for measurement of the direction and apparent velocity of clouds. He has now made an addition to the nephoscope, by which the absolute height of clouds may be determined without any calculation, and thence also their absolute velocity. Such an instrument has been wanting in meteorology, and will certainly be useful. Of course the cloud chosen for measurement must be isolated and not very high, and the place of operation must be elevated and so placed as to command a view of the cloud's shadow. It is the height of the cloud above its shadow, not above the place of observation, which is obtained. The old method may still be followed with the nephoscope, but it is more laborious. The instrument is minutely described with reference to an annexed woodcut.—Among the *Kleinere Mittheilungen* we have a notice of Prof. Lommel's book, "Wind und Wetter." His explanation of the curves of storms issuing from the region of trade winds is somewhat as follows:—The rotation of the cyclone being in the N.E. trade wind from N. through W. and S. to E., the N.E. trade wind opposes and retards the S.E. portion, but accelerates the N.W. portion of the whirl. Thus the pressure will be least in the N.W., greatest in the S.E. quarter, and progress will be made towards the N.W. Arrived in the region of variable winds, the course will be changed according to the direction of the prevailing wind. Supposing a storm to be on the western coasts of Europe, and the most common wind, S.W., to be blowing, the direction of progress will be E. or E.S.E., and this is actually the course commonly taken by European storms.

Memorie della Societa degli Spettroscopisti Italiani, July.—This number contains an announcement of the death of Paolo Rosa at Rome on the 11th of July, and a short statement of his scientific labours; it also contains a letter from P. Rosa on the connection of solar activity and rainfall, and a paper by the same author on the identity of photospheric and magnetic phenomena in connection with the proper motion of the sun. Tables are given showing a corresponding variation of the magnetic variation with the changes in the solar diameter, there being an 11-year period of both, and also a secular period of 66¾ years. Secchi writes that the spectrum of Coggia's comet corresponded with that of a hydrocarbon, and that the continuous spectrum observed therewith was due to reflected sunlight, since it disappeared on interposing a Nicol's prism. Prof. Bredichin fixes the lines at 5633, 5164, and 4742 of Angstrom's scale; and Tacchini at 6770, 5620, 5110, and 4800; the longest was 5620, and the brightest 5110. The chromosphere as seen in January last is shown in a drawing by Tacchini, and he adds that he has seen the chromosphere steadily at an altitude of 3° from the horizon, and when the limb of the sun was very unsteady in a simple telescope.—Tacchini sends a note that four bolides travelling together entered our atmosphere on the 27th of July, the position and drawing is given; they were seen for 40 seconds.—A number of drawings of Coggia's comet are sent by Tacchini, with a descriptive statement. Wright adds a note that the comet's light was polarised.

Journal de Physique, tome iii., Nos. 29, 30.—In these two numbers is an article by M. Berthelot on the principles of Thermo-chemistry. The study of the evolution of heat in chemical combinations is a new branch of science belonging partly to physics and partly to chemistry, and the number of facts already observed is sufficiently numerous to indicate certain laws which M. Berthelot proceeds to set forth. It is, he premises, admitted that in a chemical combination the molecules hit sharply one against another and give off heat, just as when a hammer strikes a bar of iron. From a study of the relations between the amount of heat evolved and the amount of work done, it is possible to establish some theorems of Thermo-chemistry. 1. First principle. The amount of heat given off in any reaction is a measure of the chemical or physical work done in that reaction. Several examples are given. 35·5 grs. of chlorine unite with 1 gr. of hydrogen and form hydrochloric acid, giving off 22 calories. The compound occupies the same volume as its component parts. Here the physical work is *nil* and the chemical is 22 E (E being the mechanical equivalent of heat.) Again, 8 grs. of O unite with 1 of H to form water. At ordinary temperatures the heat evolved is 34·5 calories. But there is a change from gas to liquid. Part of the work is chemical, part physical. It is shown, then, that the temperature affects the amount of heat evolved; this is due to the physical work of exterior pressure. All computations should, when possible, be made with both the components and the compound in the state of gas. This is not always possible; hence the importance of the second principle. 2. If a system of simple or compound bodies taken in certain conditions lead to physical or chemical changes which bring about a fresh state without giving rise to any mechanical result, then the heat given off or absorbed by these changes depends entirely on the first and last conditions of the system. The intermediate states do not affect it. For example: $C + O_2 = CO_2$ gives 47 calories. Or, $C + O = CO$ gives 34·5; and then, $CO + O = CO_2$ gives 12·5, and 34·5 + 12·5 = 47 as before. We have not space to notice the five "consequences" from this principle. 3. Third principle. Every chemical change effected without the intervention of any external energy leads to the production of a body, or system of bodies, which give off more heat. For example: $Sn + O = SnO$ gives off in formation 36·9 Cal.; $Sn + O^2 = SnO_2$ gives 72·7. Some compounds cannot be formed by their own energy—*e.g.* acetylene is formed by the union of C and H, but it requires the energy of an electric current to induce it.—M. Laurent describes a new saccharometer.—M. Mascart contributes an article on the annealing of glass, having special reference to the preparation of objectives.—M. Blavier's paper, continued from No. 28, is concluded.—M. Marcy describes a new chronograph of a small size convenient for holding in the hand, based on the principle of Duhamel's.—There is also an article by M. Thurot on Galileo's experiments on weight.

Annali di Chimica applicata alla Medicina, No. 2, vol. lix., August.—The present number begins with a paper in pharmacy On the reactions of morphine, from researches by Hermann, Kelbrunser, Siebold, and Schneider.—In dietetics, Prof. Fr. Selmi contributes a paper entitled "New Study of Milk," and there is also one by Dr. Martin on *koumiss*, a vinous liquid obtained by the fermentation of milk.—In toxicology there is a paper by Pietro Albertoni and Filippo Lussana on the physiological criterion for medico-legal proofs of poisoning.—In physiology, Prof. G. See furnishes a paper on the action of the salts of potassium.—Under "Varieties" there are the following papers:—On the culture of *Eucalyptus globulus*, by Dr. Ledeganck.—The blue colour of linen used for medical purposes, by Louquet.—Use of chloroform and ether for stupefying bees, by Chairon.—Phenol-camphorated oil for the gummy disease of fruits, by Dr. F. F. Adorni.—Bisulphite of soda as an antichlore for bleaching, by Dr. T. Schuchardt.—The part concludes with a biological notice of Justus Liebig, by G. Ruspini, and a review of the fourth part of the *Annuaris delle Scienze Mediche*, published by Drs. P. Schivardi and G. Pini.

SOCIETIES AND ACADEMIES

PHILADELPHIA

Academy of Natural Sciences, April 7.—Dr. Jos. Leidy in the chair.—"The Blue Gravel of California," by E. Goldsmith. Under the name of "Blue Gravel" the California gold miners, and especially the placer miners, understand a rock which underlies the gold-bearing alluvium of that State and part of Nevada. It is stated that whenever the gold-bearing sand in many localities in the two above-named States has been removed by the well-known washing process, the "blue gravel" appears. It also contains gold, which cannot, however, be extracted by washing, the stream of water being unable to disintegrate the rock, which is a compact composite one, and not, as the name "gravel" would imply, a loose material. This so-called "blue gravel" is composed of two ingredients widely differing in age, namely, of pebbles cemented together by a lava. The pebbles are of all sizes. From the general appearance I infer that some of these pebbles were derived from the sedimentary rock, slate, and others from hornblende rock. Entirely different in general aspect from the rounded pebbles is the other part of the rock, which I have already stated to be a lava. This appears to envelop the pebbles completely. This lava is very brittle, so much so that the preparation of a thin plate for microscopical observation is impossible. The hardness is equal to apatite. The most distinguishing crystallisation within the lava mass is a black mica, which is probably biotite. I noticed also a few grains of quartz, as well as flattened grains of bright yellow gold. The conclusion at which I arrive is that the so-called "blue gravel" of California is a conglomerate of pebbles of various kinds cemented together by an acidic lava in which crystals of mica (biotite) and grains of gold are imbedded. How the gold came into the lava is a question of some difficulty. Whether it was mingled with the pebbles before the lava ran over the bed, or whether the gold was ejected from the volcano, I am not able to decide.

April 14.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy called attention to the "Bulletin of the United States Geological and Geographical Survey of the Territories, No. 2," presented this evening. It contains a "Review of the Vertebrata of the Cretaceous Period found west of the Mississippi River," by Prof. Cope. In this article he was quoted in such a way as not fairly to express his original meaning. Thus, on one page reference is made to the proceedings of this Academy, in which it is intimated that *Thespesius occidentalis* was referred to the Mammalia, and regarded, perhaps, as a Dinosaurian. "In the Proceedings I have rather expressed the reverse, as I state of *T. occidentalis*, among the collection of vertebrate remains, are two apparent caudal vertebræ and a first phalanx of some huge animal, which I suspect to be a Dinosaurian, though they may have belonged to a mammalian. I may add that Prof. Cope, quoting from the same Proceedings, indicated that I had referred Ischyrotherium to a Sirenian. This is so, but Prof. Cope appears to have overlooked the more full account of the animal in the Trans. of the Am. Phil. Soc., in which, though I still refer it with doubt to the mammalia sirenia, I state that the remains may have belonged to an aquatic reptile."

May 12.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy gave a notice of some new freshwater Rhizopods, having all the essential characters of Amœba, but, in addition, provided with tufts of tail-like appendages or rays, from which he proposed to name the genus Ouramœba. It is possible that Ouramœba is the same as the Plagiophrys of Claparede, though the description of this does not apply to that.—Dr. Chapman made the following remarks on the generative apparatus of the *Tebennophorus carolinensis*:—He found both ova and spermatozoa in the organ regarded first as simply the ovary, later as the testicle.

May 19.—Dr. Kenderdine in the chair.—"The Veins of Beech and Hornbean Leaves." Mr. Thomas Meehan said that De Candolle had noticed some years since a difference in the venation between the *Fagus ferruginea* and *Fagus sylvatica*, the common American and European beeches. In the American beech the lateral veins were said to terminate in the apex of the serratures, in the European they terminate at the base of the sinus. As the statement stood, it conveyed the idea that there was a marked difference in structure between these two allied species, which did not, however, exist, as growing in this country the leaves of the European beech are almost entire; the lateral veins, in approaching the margin of the leaves, curve upwards, and connect with the lateral above them, forming a sort of marginal vein near the outer edge of the leaf. The veins of the American beech curve upward in the same way, but are easily arrested, and this sudden cessation of growth produces the serra, which are slightly curved upwards.—"Direct Growth Force." Mr. Meehan referred to some potatoes exhibited by him to the Academy a few years ago, in which the stolons of a grass had penetrated through from one side to the other, preferring, as it would seem, to go through such an obstruction to turning aside to avoid it. A potato was a rather rough-surfaced body. He now exhibited a similar case, only the obstruction was the round smooth root of an herbaceous peony. Though not more than one-third of an inch thick and round, a stolon of *Triticum repens*, the common couch grass, had pushed itself through.

May 26.—Dr. Ruschenberger, president, in the chair.—On report of the committee to which it had been referred, the following paper was ordered to be published:—"Description of two new fossil shells of the Upper Amazon," by T. A. Conrad.

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DIARY OF SOCIETIES.

LONDON

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THURSDAY, OCTOBER 15, 1874

THE UNIVERSITIES COMMISSION REPORT

I.

THE publication of this Report has been awaited with an interest which rarely attends the issue of a Blue Book: and though the Commissioners have taken two years and a half over their labours, the result, both in its matter and its form, fully justifies their apparent delay. We have here presented to us in a concise and intelligible shape, the entire financial affairs of the Universities of Oxford and Cambridge with their Colleges. The whole property of these wealthy institutions, its sources and its application, the probability of its increase, and their annual income and expenditure, are now for the first time laid before the public.

It is in itself no small thing that these ancient corporations, with one single exception, should have been prevailed upon without direct Parliamentary pressure to reveal their most cherished secrets: for it should be remembered that only twenty years ago the first University Commission failed totally in its attempt to extract similar information from the unreformed Colleges, and that even up to the present time not even a University man had materials from which to form a reasonable conjecture as to the wealth of any other College than that of which he might happen to be a Fellow. It must be admitted that the Colleges come out from this ordeal of publicity with a better show than even their friends had anticipated. To produce the elaborate returns which the Commissioners required, an immense amount of additional labour has been thrown upon the College Bursars, who, as the Report bears witness, are not over-abundantly requited for the large amount of work they do as managers of landed estates and treasurers of the general accounts. The Master of Sidney Sussex College, Cambridge, who is also Bursar, has alone proved recalcitrant; but as to all the rest, it is pleasant to read the language in which the Commissioners express their gratitude for the ready assistance which they have received, and the spirit of marked courtesy with which they have been met. It had been generally anticipated that the system of managing estates through these amateur land-agents would not be proved to be economical, but the facts seem to have been unexpected even by the Commissioners, who report that the cost of management of the whole external income averages somewhat under 3*l.* per cent. They also state that they have no reason to believe that the condition of the estates let at rack rent is below the average, though probably less outlay is made than by private landlords who improve their properties. There is, however, a large quantity of land still let on the old system of beneficial leases, concerning which method of letting a clear description is given in the Report, and the agricultural condition of this land is confessedly bad; but this mode of tenure is universally condemned, and is in process of being rapidly extinguished.

With regard to the internal income and its expenditure, the Commissioners are unable, owing to the complicated and varying manner in which these accounts are kept, to arrive at any general conclusions, but they condemn in unhesitating terms the custom which appears to prevail everywhere at Cambridge, by which the payments of the undergraduates as caution money and tuition fees are made directly to the College tutor, who not unnaturally is induced to regard this arrangement as a private affair between himself and his pupil, so that in some cases information on this subject has been unwillingly given, and in some others altogether withheld. Some disapproval also is expressed of the general mode in which the College accounts are kept, which may be explained by the circumstance that they were never intended for publicity, and in many instances retain the old Latin nomenclature. It was only in a few cases that a correctly drawn balance-sheet was obtainable, and in some cases the accounts of Trust funds are not kept properly distinct, and the balances of such accounts seem to be occasionally borrowed for the general purposes of the College, and no interest allowed. It is further observed that there is no case of audit by a professional auditor. These criticisms, after all, are upon minor matters, but they have a certain importance as showing that the Commissioners have been both searching in their inquiries and fearless in their comments, and also because from the terms of their appointment they were not permitted to make any more general recommendations with regard to the wide question of the uses of academical endowments.

The real value of this Report of course lies in the long and elaborate array of figures which it gives, and in its impressive totals. A mine of reliable information is here afforded to University reformers and all those who are interested in the advancement of science, from which they may learn how vast is the wealth at their disposal, and from which they may securely draw materials for a comprehensive scheme. The total income of the Universities and Colleges in the year 1871, which is the year which the Commissioners have fixed upon for all their calculations, amounted to no less than three quarters of a million, and the number of undergraduates was about 3,500. Of this total, Oxford receives the larger share by more than 70,000*l.*, while the number of undergraduates is just equal. Another calculation gives the external income of Oxford (by which term the Commissioners intend the revenue from endowments) at 336,000*l.*, and the internal income of the Oxford Colleges, which is mainly derived from dues, fees, and profits of establishment, at 58,000*l.*, besides tuition fees at 30,000*l.*, whereas the sum of only 41,000*l.* is spent in scholarships, exhibitions, &c. These figures should be compared with those lately given to the public in the Fifth Report of the Royal Commission on Scientific Instruction, which dealt with such voluntary institutions as University and King's Colleges, London, and Owens College, and from such comparison the conclusion will inevitably be drawn that University education is capable of being made self-supporting, and that the University endowments can only be justified in so far as they encourage, not the teaching, but the advancement of learning and science.

This conclusion is also strongly supported by a more minute examination of the figures in this Report bearing on the income and expenditure of the several Colleges. It has long been well known that the educational utility of a College bears no relation to the value of its endowments, but this truth can now be enforced by very definite examples. King's College, Cambridge, has a revenue from endowment of 34,000*l*., and has from 20 to 30 undergraduates; Exeter College, Oxford, has an endowment of less than 6,000*l*., and educates 180 undergraduates, from whose payments a profit is derived which exceeds the external income by nearly 6,000*l*. A comparison also between Corpus Christi College, Oxford, where the sum of 975*l*. in the year is actually drawn from the endowments to pay the balance of the kitchen and buttery accounts, and Keble College, which has absolutely no endowment and yet exhibits a profit of 500*l*. on the year's account, equally teaches the lesson that out of tutorial and other fees, and fair boarding charges, an unendowed institution is capable of paying its own way, even in the face of competition with extravagant endowments. It appears, then, that by far the larger portion of the University endowments are not applied to educational purposes proper, nor apparently is it desirable that more should be devoted to that object, so that those are proved to be not far wrong who have urged that all this wealth is in the main wasted upon sinecures, and is readily available for the direct advancement of science and pure learning. At Oxford, the Heads of Houses and Fellows, more than two-thirds of whom are non-resident, receive yearly 131,000*l*., and the remainder of the revenue is expended upon various minor charges which are probably inseparable from the possession of large landed estates and considerable buildings and grounds. It is then to this 131,000*l*. that the attention of reformers must be directed, and the question of its proper uses becomes the more important when it is added that the Commissioners anticipate that in the next fifteen years the Colleges will receive an increase, due to the falling in of beneficial leases, of 123,000*l*. It is probable, nay, almost certain, that this total will be considerably increased, partly by a general rise in the value of land, and partly through building leases, so that by the end of this century Oxford will have a yearly sum of 260,000*l*. upon which there is no present claim of more importance than those of Headships and Fellowships. If the revenues of Cambridge are treated according to the same principle of calculation, the amount paid to scholars and expended in general purposes being knocked off and the probable increase being included, the Colleges of that University will have at the same date about 160,000*l*., so that Oxford will then appear even more than now the richer of the two. In our next article we shall point out how this large sum might be yet further increased, if the connection with the Church of England, which has always hampered to so great an extent the usefulness of the Colleges, were finally severed, and if all the academical endowments were to be strictly applied to academical purposes; but even without such severance a sufficient surplus is shown to induce the much-desired agreement as to its proper application, so that it may not continue to be wasted, nor diverted, as some have suggested, to the great towns; a mode of action which will induce all towns to do nothing in order that the Universities may eventually help them, and more than ever justify the French criticism that our Universities are nothing more than *Hautes Lycées*, instead of being, as they should be, the active centres of learning and research. It is to a Liberal Ministry that we owe the Commission which has yielded this valuable Report, but according to all appearances it will be a Conservative Government that must undertake the more important task of inaugurating the work of fundamental University Reform.

METEOROLOGICAL REFORM

WE would invite our readers' attention to an article which appears in this number of NATURE on the necessity for placing Physical Meteorology on a rational basis.

It forms the substance of a paper brought before the recent meeting of the British Association by Col. Strange, who has taken, as our readers well know, a very prominent part in the reconstruction of British Science, and to whom we are indebted for the present very earnest and lucidly argued protest in favour of a more rational way of treating meteorology.

He begins by dividing meteorology into two branches—one of these relating to weather and climate and their effects on organised life; while the other deals with the great physical motions of the atmosphere and with their causes.

To know beforehand the climatic peculiarities of a watering-place or country seat is no doubt of much importance, especially for an invalid who is in search of a healthy locality, but this does not constitute physical meteorology. It forms, we venture to think, a more important and certainly a more difficult branch of inquiry to study the earth's envelope as a whole, to ascertain the nature of the movements to which the moveable parts of it are subject, and finally to investigate the physical causes of these. It is in this latter aspect that the meteorology of the day is so lamentably deficient. The great fault in the present system has been well put by Col. Strange.

Two things have been taken for granted by meteorologists. In the first place, it has been imagined that the sun affects the earth in only one way, namely, by means of its radiation; and secondly, they appear to have taken for granted that this radiant influence is a constant quantity. So much indeed have these most important factors been overlooked, that we believe no systematic effort has yet been made to measure the sun's radiant influence, and indeed no proper instrument has yet been devised by which this can be done in a satisfactory manner. Without doubt the great question for meteorologists is that put by Col. Strange: "Is the sun a constant quantity?"

Now, if the evidence in favour of the sun's constancy were absolutely overwhelming, even then the present system would be at fault, inasmuch as no systematic attempts have been made to measure the strength of the solar influence: but how much more is the system deficient when it refuses to investigate an influence which is certainly predominant and most probably inconstant. To give our readers some idea of the evidence in favour of this latter assertion, let us quote the following words from a letter contained in a report presented to the British Association by a committee appointed to consider the question of scientific organisation:—

"Recent investigations have increased the probability of a physical connection between the condition of the sun's surface, and the meteorology and magnetism of our globe.

"In the first place, we have the observations of Sir E. Sabine, which seem to indicate a connection between sun-spots and magnetic disturbances, inasmuch as both phenomena are periodical, and have their maxima and minima at the same times.

"On the other hand, the researches of Messrs. Baxendell and Meldrum appear to indicate a relation between the wind-currents of the earth and its magnetism, and also between the earth's wind-currents and the state of the sun's surface.

"In the last place, the researches of Messrs. De la Rue, Stewart, and Loewy appear to indicate a connection between the behaviour of sun-spots and the positions of the more prominent planets of our system. Whatever be the probability of the conclusions derived from these various researches, they at least show the wisdom of studying together for the future these various branches of observational science."

A further report by the same committee tells us that "It is not enough to obtain a record of the areas and positions of the various sun-spots. The velocity of cyclonic motion, the chemical nature of the outbursts, the disposition and character of the faculæ and prominences, and many other points, are, as shown by Mr. Lockyer, even more characteristic of the nature of solar action than the magnitude of the spotted area, and are equally worthy of a careful and constant study."

The evidence in favour of some strange and variable action of the sun may, perhaps, be compared to that in favour of the existence of America before that continent was discovered by Columbus; and it might have been thought that in an age like the present the difficulty of organising solar research would be very much less than that experienced by Columbus in organising an American expedition; but this is not the case. Indeed, it is not very creditable to the scientific authorities of this country that they have not entered more readily into a subject of this importance. From the quotations given above, our readers will see that this is not the first time the subject has been brought before the British Association.

A large and influential committee, embracing in its ranks many of the most distinguished members of the Association, endeavoured to bring the subject before the Administrative Council of that body, but did not succeed in getting the Council to move in the matter, or even to pronounce any opinion upon the subject. We hardly think this was proper treatment of an important problem, which had found such advocates as Col. Strange, Drs. De la Rue and Joule, Messrs. Baxendell, Lockyer, and Meldrum, as well as the general support of the most distinguished physicists of the country.

Clearly Col. Strange is right in supposing that a problem of this importance and extent can be properly undertaken only by Government. His remarks on this subject are so well put that we will report them here. Starting with the fundamental axiom that private enterprise should be allowed the most perfect freedom from interference or competition by the State, he lays down the following conditions for Government action in any scientific problem:—

(*a*) That the probable results of the research be beneficial, in the widest sense of that term, to the community at large, or to the various departments of the State.

(*b*) That the research is too costly or commercially too unremunerative to be undertaken and vigorously prosecuted by individuals.

(*c*) That the research requires continuous, uninterrupted work, extending over very long periods, and conducted by systematically organised establishments.

It will at once be seen that all these conditions apply to solar research; and the Governments of other nations have already perceived the fact. Our readers are aware that the Governments of France and America have it in contemplation to establish solar observatories, and a recent number of this periodical informs them that the German Government has already founded one on a large scale, of which it is possible the illustrious Kirchhoff will be the Director.

In conclusion, as we are advocating a question of reform, it is desirable that something in the shape of practical suggestions should be made. Now, in the first place and with reference to the great problem of Solar Physics, we think that this should certainly be encouraged by the establishment of a distinct central observatory devoted to the purpose; for it would be manifestly unfair to our illustrious Astronomer Royal to throw upon him the additional burden of an institution so very different from that over which he now presides.

In the next place, with reference to photographical delineations of the solar disc, Col. Strange has made a suggestion, at once so practical and simple, that we cannot do better than quote his own words:—

"With respect to sun-spot researches, it fortunately happens that the photographic records need not be all taken at the same station. The record of one day taken in England can be combined with the record of the next day taken at the other side of the globe. Hence, in order to obtain this daily record it is only necessary to select a certain number of stations in localities such that there shall always be clear weather at one of them. India offers peculiar facilities for such a selection of stations, owing to the great variety of climate to be found in that country during the same period of the year. Perhaps four or five such stations would suffice for India, and if absolute continuity of record could not be obtained by them, the deficiencies could easily be made good by stations in our colonial possessions."

It is well known how slowly such things march in this country; nevertheless we look with much confidence to the forthcoming report of the Royal Commission appointed to investigate matters of this nature, and to urge upon Government such means as they consider shall tend to the advancement of science and to the good of the country.

BALFOUR STEWART

VAN DER WAALS ON THE CONTINUITY OF THE GASEOUS AND LIQUID STATES

Over de continuiteit van den gas- en vloeistoftoestand. Academisch proefschrift. Door Johannes Diderik van der Waals. (Leiden: A. W. Sijthoff, 1873.)

THAT the same substance at the same temperature and pressure can exist in two very different states, as a liquid and as a gas, is a fact of the highest scientific importance, for it is only by the careful study of the difference between these two states, the conditions of the substance passing from one to the other, and the phenomena which occur at the surface which separates a liquid from its vapour, that we can expect to obtain a dynamical theory of liquids. A dynamical theory of "perfect" gases is already in existence; that is to say, we can explain many of the physical properties of bodies when in an extremely rarefied state by supposing their molecules to be in rapid motion, and that they act on one another only when they come very near one another. A molecule of a gas, according to this theory, exists in two very different states during alternate intervals of time. During its encounter with another molecule, an intense force is acting between the two molecules, and producing changes in the motion of both. During the time of describing its free path, the molecule is at such a distance from other molecules that no sensible force acts between them, and the centre of mass of the molecule is therefore moving with constant velocity and in a straight line.

If we define as a perfect gas a system of molecules so sparsely scattered that the aggregate of the time which a molecule spends in its encounters with other molecules is exceedingly small compared with the aggregate of the time which it spends in describing its free paths, it is not difficult to work out the dynamical theory of such a system. For in this case the vast majority of the molecules at any given instant are describing their free paths, and only a small fraction of them are in the act of encountering each other. We know that during an encounter action and reaction are equal and opposite, and we assume, with Clausius, that on an average of a large number of encounters the proportion in which the kinetic energy of a molecule is divided between motion of translation of its centre of mass and motions of its parts relative to this point approaches some definite value. This amount of knowledge is by no means sufficient as a foundation for a complete dynamical theory of what takes place during each encounter, but it enables us to establish certain relations between the changes of velocity of two molecules before and after their encounter.

While a molecule is describing its free path, its centre of mass is moving with constant velocity in a straight line. The motions of parts of the molecule relative to the centre of mass depend, when it is describing its free path, only on the forces acting between these parts, and not on the forces acting between them and other molecules which come into play during an encounter. Hence the theory of the motion of a system of molecules is very much simplified if we suppose the space within which the molecules are free to move to be so large that the number of molecules which at any instant are in the act of encountering other molecules is exceedingly small compared with the number of molecules which are describing their free paths. The dynamical theory of such a system is in complete agreement with the observed properties of gases when in an extremely rare condition.

But if the space occupied by a given quantity of gas is diminished more and more, the lengths of the free paths of its molecules will also be diminished, and the number of molecules which are in the act of encounter will bear a larger proportion to the number of those which are describing free paths, till at length the properties of the substance will be determined far more by the nature of the mutual action between the encountering molecules than by the nature of the motion of a molecule when describing its free path. And we actually find that the properties of the substance become very different after it has reached a certain degree of condensation. In the rarefied state its properties may be defined with considerable accuracy in terms of the laws of Boyle, Charles, Gay-Lussac, Dulong and Petit, &c., commonly called the "gaseous laws." In the condensed state the properties of the substance are entirely different, and no mode of stating these properties has yet been discovered having a simplicity and a generality at all approaching to that of the "gaseous laws." According to the dynamical theory this is to be expected, because in the condensed state the properties of the substance depend on the mutual action of molecules when engaged in close encounter, and this is determined by the particular constitution of the encountering molecules. We cannot therefore extend the dynamical theory from the rarer to the denser state of substances without at the same time obtaining some definite conception of the nature of the action between molecules when they are so closely packed that each molecule is at every instant so near to several others that forces of great intensity are acting between them.

The experimental data for the study of the mutual action of molecules are principally of two kinds. In the first place we have the experiments of Regnault and others on the relation between the density, temperature, and pressure of various gases. The field of research has been recently greatly enlarged by Dr. Andrews in his exploration of the properties of carbonic acid at very high pressures. Experiments of this kind, combined with experiments on specific heat, on the latent heat of expansion, or on the thermometric effect on gases passing through porous plugs, furnish us with the complete theory of the substance, so far as pure thermodynamics can carry us.

For the further study of molecular action we require experiments on the rate of diffusion. There are three kinds of diffusion—that of matter, that of visible motion, and that of heat. The inter-diffusion of gases of different kinds, and the viscosity and thermal conductivity of a gaseous medium, pure or mixed, enable us to estimate the amount of deviation which each molecule experiences on account of its encounter with other molecules.

M. Van der Waals, in entering on this very difficult inquiry, has shown his appreciation of its importance in the present state of science; many of his investigations are conducted in an extremely original and clear manner; and he is continually throwing out new and suggestive ideas; so that there can be no doubt that his name will soon be among the foremost in molecular science.

He does not, however, seem to be equally familiar, as yet, with all parts of the subject, so that in some places, where he has borrowed results from Clausius and others, he has applied them in a manner which appears to me erroneous.

He begins with the very remarkable theorem of Clausius, that in stationary motion the mean kinetic energy of the system is equal to the mean virial. As in this country the importance of this theorem seems hardly to be appreciated, it may be as well to explain it a little more fully.

When the motion of a material system is such that the sum of the moments of inertia of the system about three axes at right angles to each other through its centre of mass does not vary by more than small quantities from a constant value, the system is said to be in a state of stationary motion. The motion of the solar system satisfies this condition, and so does the motion of the molecules of a gas contained in a vessel.

The kinetic energy of a particle is half the product of its mass into the square of its velocity, and the kinetic energy of a system is the sum of the kinetic energy of its parts.

When an attraction or repulsion exists between two points, half the product of this stress into the distance between the two points is called the Virial of the stress, and is reckoned positive when the stress is an attraction, and negative when it is a repulsion. The virial of a system is the sum of the virial of the stresses which exist in it.

If the system is subjected to the external stress of the pressure of the sides of a vessel in which it is contained, the amount of virial due to this external stress is three halves of the product of the pressure into the volume of the vessel.

The virial due to internal stresses must be added to this.

The theorem of Clausius may now be written—

$$\tfrac{1}{2}\Sigma(m\overline{v^2}) = \tfrac{3}{2}pV + \tfrac{1}{2}\Sigma\Sigma(Rr)$$

The left-hand member denotes the kinetic energy.

On the right hand, in the first term, p is the external pressure on unit of area, and V is the volume of the vessel.

The second term represents the virial arising from the action between every pair of particles, whether belonging to different molecules or to the same molecule. R is the attraction between the particles, and r is the distance between them. The double symbol of summation is used because every pair of points must be taken into account, those between which there is no stress contributing, of course, nothing to the virial.

As an example of the generality of this theorem, we may mention that in any framed structure consisting of struts and ties, the sum of the products of the pressure in each strut into its length, exceeds the sum of the products of the tension of each tie into its length, by the product of the weight of the whole structure into the height of its centre of gravity above the foundations. (See a paper on "Reciprocal Figures, &c." Trans. R. S. Edin., vol. xxvi. p. 14. 1870.)

In gases the virial is very small compared with the kinetic energy. Hence, if the kinetic energy is constant, the product of the pressure and the volume remains constant. This is the case for a gas at constant temperature. Hence we might be justified in conjecturing that the temperature of any one gas is determined by the kinetic energy of unit of mass.

The theory of the exchange of the energy of agitation from one body to another is one of the most difficult parts of molecular science. If it were fully understood, the physical theory of temperature would be perfect. At present we know the conditions of thermal equilibrium only in the case of gases in which encounters take place between only a pair of molecules at once. In this case the condition of thermal equilibrium is that the mean kinetic energy due to the agitation of the centre of mass of a molecule is the same, whatever be the mass of the molecule, the mean velocity being consequently less for the more massive molecules.

With respect to substances of more complicated constitution, we know, as yet, nothing of the physical condition on which their temperature depends, though the researches of Boltzmann on this subject are likely to result in some valuable discoveries.

M. Van der Waals seems, therefore, to be somewhat too hasty in assuming that the temperature of a substance is in every case measured by the energy of agitation of its individual molecules, though this is undoubtedly the case with substances in the gaseous state.

Assuming, however, for the present that the temperature is measured by the mean kinetic energy of a molecule, we obtain the means of determining the virial by observing the deviation of the product of the pressure and volume from the constant value given by Boyle's law.

It appears by Dr. Andrews' experiments that when the volume of carbonic acid is diminished, the temperature remaining constant, the product of the volume and pressure at first diminishes, the rate of diminution becoming more and more rapid as the density increases. Now, the virial depends on the number of pairs of molecules which are at a given instant acting on one another, and this number in unit of volume is proportional to the square of the density. Hence the part of the pressure depending on the virial increases as the square of the density, and since, in the case of carbonic acid, it diminishes the pressure, it must be of the positive sign, that is, it must arise from *attraction* between the molecules.

But if the volume is still further diminished, at a certain point liquefaction begins, and from this point till the gas is all liquefied no increase of pressure takes place. As soon, however, as the whole substance is in the liquid condition, any further diminution of volume produces a great rise of pressure, so that the product of pressure and volume increases rapidly. This indicates negative virial, and shows that the molecules are now acting on each other by *repulsion*.

This is what takes place in carbonic acid below the temperature of 30·92° C. Above that temperature there is first a positive and then a negative virial, but no sudden liquefaction.

Similar phenomena occur in all the liquefiable gases. In other gases we are able to trace the existence of attractive force at ordinary pressures, though the compression has not yet been carried so far as to show any repulsive force. In hydrogen the repulsive force seems to prevail even at ordinary pressures. This gas has never been liquefied, and it is probable that it never will be liquefied, as the attractive force is so weak.

We have thus evidence that the molecules of gases attract each other at a certain small distance, but when they are brought still nearer they repel each other. This is quite in accordance with Boscovich's theory of atoms as massive centres of force, the force being a function of the distance, and changing from attractive to repulsive, and back again several times, as the distance diminishes. If we suppose that when the force begins to be repulsive it increases very rapidly as the distance diminishes, so as to become enormous if the distance is less by a very small quantity than that at which the force first begins to be repulsive, the phenomena will be precisely the same as those of smooth elastic spheres.

M. Van der Waals makes his molecules elastic spheres, which, when not in contact, attract each other. His treatment of the "molecular pressure" arising from their attraction seems ingenious, and on the whole satisfactory, though he has not attempted a complete calculation of the attractive virial in terms of the law of force.

His treatment of the repulsive virial, however, shows a departure from the principles on which his investigation is founded. He considers the effect of the size of the molecules in diminishing the length of their "free paths," and he shows that this effect, in the case of very rare gases, is the same as if the volume of the space in which the molecules are free to move had been diminished by four times the sum of the volumes of the molecules themselves. He then substitutes for V, the volume of the vessel in Clausius' formula, this volume diminished by four times the molecular volume, and thus obtains the equation—

$$\left(p + \frac{a}{V^2}\right)(V - b) = R(1 + \alpha t),$$

where p is the externally applied pressure, $\frac{a}{V^2}$ is the molecular pressure arising from attraction between the molecules, which varies as the square of the density, or inversely as the square of the volume. The first factor is thus what he considers the total effective pressure. V is the volume of the vessel, and b is four times the volume of the molecules. The second factor is therefore the "effective volume" within which the molecules are free to move.

The right hand member expresses the kinetic energy, represented by the absolute temperature, multiplied by a quantity, R, constant for each gas.

The results obtained by M. Van der Waals by a comparison of this equation with the determinations of Regnault and Andrews are very striking, and would almost persuade us that the equation represents the true state of the case. But though this agreement would be strong evidence in favour of the accuracy of an empirical formula devised to represent the experimental results, the equation of M. Van der Waals, professing as it does to be derived from the dynamical theory, must be subjected to a much more severe criticism.

It appears to me that the equation does not agree with the theorem of Clausius on which it is founded.

In that theorem p is the pressure of the sides of the vessel, and V is the volume of the vessel. Neither of these quantities is subject to correction.

The assumption that the kinetic energy is determined by the temperature is true for perfect gases, and we have no evidence that any other law holds for gases, even near their liquefying point.

The only source of deviation from Boyle's law is therefore to be looked for in the term $\frac{1}{2}\Sigma\Sigma(Rr)$, which expresses the virial. The effect of the repulsion of the molecules, causing them to act like elastic spheres, is therefore to be found by calculating the virial of this repulsion.

Neglecting the effect of attraction, I find that the effect of the impulsive repulsion reduces the equation of Clausius to the form—

$$pV = \tfrac{1}{3}\Sigma(m\overline{v^2})\left\{1 - 2\log.\left(1 - 8\frac{\rho}{\sigma} + 17\frac{\rho^2}{\sigma^2} - \&c.\right)\right\}$$

where σ is the density of the molecules and ρ the mean density of the medium.

The form of this equation is quite different from that of M. Van der Waals, though it indicates the effect of the impulsive force in increasing the pressure. It takes no account of the attractive force, a full discussion of which would carry us into considerable difficulties.

At a constant temperature the effect of the attractive virial is to diminish the pressure by a quantity varying as the square of the density, as long as the encounters of the molecules are, on the whole, between two at a time, and not between three or more. The effect of the attraction in deflecting the paths of the molecules is to make the number of molecules which at any given instant are at distances between r and $r + dr$ of each other greater than the number in an equal volume at a greater distance in the proportion of the velocities corresponding to these distances. As the temperature rises, the volume being constant, the ratio of these velocities approaches to unity, so that the distribution of molecules according to distance becomes more uniform, and the virial is thus diminished.

If there is a virial arising from repulsive forces acting through a finite distance, a rise of temperature will increase the amount of this kind of virial.

Hence a rise of temperature at constant volume will produce a greater increase of pressure than that given by the law of Charles.

The isothermal lines at higher temperatures will exhibit less of the diminution of pressure due to attraction, and as the density increases will show more of the increase of pressure due to repulsion.

I must not, however, while taking exception to part of the work of M. Van der Waals, forget to add that to him alone are due the suggestions which led me to examine the theory of virial more carefully in order to explore the continuity of the liquid and the gaseous states.

I cannot now enter into the comparison of his theoretical results with the experiments of Andrews, but I would call attention to the able manner in which he expounds the theory of capillarity, and to the remarkable phenomenon of the surface tension of gases which he tells (p. 38) has been observed by Bosscha in tobacco smoke. As tobacco smoke is simply warm air with a slight excess of carbonic acid, carrying solid particles along with it, the change of properties at the surface of the cloud must be very slight compared with that at the surface where two really different gases first come together. If, therefore, the phenomenon observed by Bosscha is a true instance of surface-tension, we may expect to discover much more striking phenomena at the meeting-place of different gases, if we can make our observations before the surface of discontinuity has been obliterated by the inter-diffusion of the gases.

J. CLERK-MAXWELL

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

An Anagram

THE practice of enclosing discoveries in sealed packets and sending them to Academies, seems so inferior to the old one of

Huyghens, that the following is sent you for publication in the old conservated form :—

$A^8C^3DE^{12}F^4GH^6I^6L^3M^3N^5O^6P$
$R^4S^5T^{14}U^6V^2WXY^2$ WEST

"Manufactured Articles"

THERE are precedents to justify a hope that it would be no excursion beyond the province of NATURE, if somebody who knows that molecules possess the essential character of a manufactured article were kindly to explain how he knows a manufactured article when he sees it, in his mind's eye or elsewhere.

The answer used to be "contrivance, design; an end, a purpose; means for the end, adaptation to the purpose." This, it was said, we find in a watch; "we perceive that its several parts are framed and put together for a purpose." The same thing, it was further said, we find still more in the works of nature, "and that in a degree which exceeds all computation." And why so much more? Because "the contrivances of nature surpass the contrivances of art, in the complexity, subtlety, and curiosity of the mechanism; and still more, if possible, do they go beyond them in number and variety." This was the old answer: the new one is contained in such phrases as these: "exact equality," "exact unison," "exactly the same magnitude," "constants not approximately but absolutely identical."

Here it is hard not to stop and ask what can possibly prove that these things are absolutely so: or what can possibly contribute the smallest probability to a hypothesis that anything is absolutely anything, I do not say among the laws of nature, but among its collocations. Very likely it might be proved that the mean-square variation in the value of one of the above-mentioned constants is a prodigiously smaller fraction of its mean value than any other fraction which the molecular theory has occasion to take account of; and anyhow the fact remains that a molecule of bismuth, for instance, differs from a molecule of lead immensely more than two molecules of either can differ from one another. Perhaps this will do as well for the argument; if so, there is no excuse for the absolute; and whether or no, the argument will be the better for explanation, or perhaps it will be the worse for the argument.

However this may be, the difference between the old answer and the new one is rather instructive. An eager disputant might say the new one was contradictory of the old one; but it is safer to say that the new is at best independent of the old. Clearly a watch is about the last thing which would be cited to illustrate the new sort of manufactured article. The examples which our authors do by preference cite are coins, weights, and measures; and certainly it would be difficult to name manufactured articles which should better exemplify uniformity for the sake of uniformity. And for a very good reason (that is the worst of it); because the purposes of coins, weights, and measures are defeated, they who handle them deceived, and (as our authors are careful to say) they who manufacture them deceivers, so far as the things are not uniform. So the inference from such things only comes to this, that uniformity is a character of manufactured articles when uniformity is part of the purpose of manufacture. Is then the new argument, after all, a special case of the old one? Not so: for when men produce as a novelty a special case of an old argument, this must be because it is an especially strong case of the same; but we have seen that the old argument owes much of its virtue to complexity and variety; therefore, our modern manufactured articles, which are above all things simple and uniform, will only furnish a special case of the old argument by furnishing an especially weak one. Design, in short, has nothing to do with the new argument, and we must look for analogies among manufactured articles which are uniform, not because uniformity adapts them to their purpose, but simply because they *are* manufactured articles.

The nearest approach I can think of is to be found on a scale almost molecular, for number and sometimes for magnitude, in a London wilderness of similar and similarly situated houses. It is oppressive to walk past these boxes so nearly identical in form, and to think of the infinite variety of their contents; to think how different they would have been, and how much fitter for their purposes, if their inhabitants could have secreted them as a snail secretes his shell. And why does it make all the difference that they have been manufactured? Why did not the manufacturer vary them according to the interests connected with them? Of course because he did not care about those interests; because he could not foresee them; and because it would not answer to try and provide for them. And now we understand the sort of manufacturer the new argument reveals: a manufacturer who does not care what becomes of his articles the moment he gets them off his hands by his formulas beginning to be interpretable; a manufacturer who cannot solve his own equations except in a grossly approximative fashion; a manufacturer who could not give his constants the proper values if he knew what values to give them.

Uniformity, in short, is not as such the sign of a manufactured article, except as it may be the sign of an imperfect manufacturer. I do not suppose this is what the new argument is meant to mean: but this, I submit, is what it does mean. Perhaps, however, some competent supporter of it will kindly explain it a little. C. J. MONRO

Yorkshire College of Science

WILL you permit a few words upon your allusion to this College in a leading article of the 8th inst.?

If its promoters have confined their present efforts to the establishment of a Faculty of Science, one cause has been that the amount of their funds compelled a selection instead of a comprehension of subjects. With a capital of 26,000*l*. they could not venture to cover so large a field as Owens College commenced upon with an invested endowment of four times the amount. But already, before our doors are opened, we have cheering signs that in providing a function to which endowments may be entrusted, the College will accrete to itself aid from widely-divergent quarters. The Royal assent has been given to an amended scheme of the Endowed Schools Commissioners for the Akroyd Charity, by which an important annual residue is allotted to the College, with representation upon the Trust. By the liberality of the Clothworkers' Company, the sum of 500*l*. per annum is set apart for three years for a Professor of Textile Industries and for Scholarships. Is it unreasonable to hope that new professorships will be established by the generosity of private individuals? The existence here of a flourishing School of Medicine is favourable to your views of massing the Faculties, and already a first link of union is being forged between the two bodies in relation to the classes in Chemistry.

Do not suppose that the College adopts *Pannus mihi panis* as its motto. A thoroughly practical community must run a risk of magnifying the *practice* of science rather than its *theory*, but if the selection of professors has been fortunate, there is no doubt that students will be taught practice through theory. Your forcible remarks will doubtless strengthen the hands of certain liberal donors to the College, who have offered increased sums when an Arts Faculty can be established.

Leeds, Oct. 12 R. REYNOLDS

On the Process of Tone-making in Organ-pipes

THE natural order of harmonic progression in an open organ-pipe is well known. That there is from the same pipe an inverse order of harmonics equally natural is not equally well known. There is no intimation that I am aware of, in any treatise on sound, of this fact having been observed, and the absence of recognition is no doubt attributable to a general disregard of the study of the comparative acoustics of musical instruments. My investigations into the process of tone-making in organ-pipes and other instruments have clearly shown me that there is *an order of transitive* harmonics distinct from the *order of concomitant* harmonics or "over-tones." Why I call them "transitive" will be apparent in the argument. Certain it is that our mimaphonic power in organ-pipes and in other musical devices depends on the command we can ensure over these two orders distinctively, and also on their comparative influences on the tones produced. In this manifestation of an inversion of harmonic progression, the nature, and, without extravagance one may say, the individuality, of the aëroplastic reed is most fully pronounced. Experimental proof is easily obtained, and, whilst bringing into prominence the peculiar display, will at the same time furnish indubitable evidence of the formative power exercised by the air-reed in the process of tone-making.

By the term "tone-making" is to be understood the manner of origination not merely of a note of defined pitch emitted by a musical instrument, but also of all the constituent sounds which give colour or quality to the note, and enter into the effect perceived by the ear. The artist, according to his sagacity, seizes on the faintest hints of nature, and with more or less consciousness of insight into law is able to control the process.

The modern theory of musical quality, or *timbre*, for which we are indebted primarily to Johannes Müller, and subsequently to Helmholtz, who by elaborate investigation has made the subject specially his own, takes account only of the varying intensities of the harmonics present in the compound tone, classed in two series, the "open" and the "stopped," or otherwise the "even" and "uneven," in regular progression. To the system of associated sounds in harmony the present inquiry has no reference; my purpose is to press the claim for recognition of another series in addition to these, to show that quality, and especially mimaphonic quality, in sounds, in whatever degree attributable to harmonics combined with the fundamental, is no less dependent for its character on the "order" in which harmonics come on or develop themselves in the growth of the tone. In plants there is a direct order of appearance—leaves, then flowers; a reversed order is as natural, and flowers come before leaves.

If an "open diapason" pipe of small scale is taken, and some slight variation made in the voicing, the pipe may be converted into a "flute harmonique," and it will give a note an octave higher than before; that is to say, the fundamental is abolished, and the octave or first harmonic reigns in its stead. The pipe will probably be now "unsteady," frequently attempting to reinstate the fundamental. This tendency we may counteract by drilling a small pin-hole at the side of the pipe, and the trifling amount of external air thereby admitted will destroy the tendency, by preventing the perfect formation of the node required by the fundamental. The perforation should be made at the true point of localisation of the node, which (as explained in a former letter in NATURE, vol. ix., p. 301) is at about $\frac{4}{7}$ of the whole length of pipe reckoned from the level of the mouth. If we next enlarge the hole at the foot of the pipe, thus allowing greater force to the wind-current, and if we have properly manipulated the pipe, we shall on the trial of its sound hear the twelfth coming on as the forerunner of the octave, most distinctly and with a perceptible interval between the appearance of the twelfth and octave. The effect is more certain if the mouth is cut to a height less than that marked by scale, which would be $\frac{1}{3}$ of the width of mouth; and if, further, the pipe is slightly coned—a provision favouring the harmonic. By other changes of treatment, the fifteenth or double octave may be brought out as the introductory harmonic, and the twelfth following, and if we will we may restore the original ground-tone. The "flute harmonique" in this style is to be chosen for this experiment, not as representative of quality, but that in this overstrained condition it clearly defines the entrance of each harmonic, the order of succession, and the interval between each. In other varieties of pipe the "quality" is characterised by these harmonics, and in this order, but so blended as it were in a "portamento" glide that even critical ears fail to detect the elements combined into the effect. It is, so to speak, "an excess" of nature, which is often necessary to open our eyes to the perception of her commonest realities.

A diapason pipe is never so strong and brilliant in character as when it is just verging on the transmutation of fundamental to octave; for good vigorous quality, therefore, it is restrained only to just within the limit; nevertheless the presence of the octave-harmonic as the precursor of the fundamental should always be felt with its jubilant energy, then afterwards, the fundamental taking full possession of the pipe, producing its own octave-harmonic with almost equal exuberance of power. The precursory harmonic is of the transitive order. We have to recognise two distinct series of open harmonics—the direct order, *over-tones of the pipe*, which are derivatives of the fundamental, and the inverse order, the tones of which may be called *stem-tones of the reed*, for they are thrown off by the reed in swift succession, and declare the non-isochronous nature of the air-reed's motion. There is nothing erratic about these stemnal harmonics or the order of their appearance; they are due to the untamed vigour of the reed, and have this distinguishing law—they are transitive, each one dies in giving birth to the next, whereas the over-tones of the pipe coexist with the fundamental, and are the direct consequence of the excess of excitation in the air-column of the pipe (see more at length in NATURE, vol. viii., p. 383), providing a safety-valve for the permanence of pitch in the ground-tone, by employing the surplus energy acquired from the reed's vivacity in new forms of growth.

Whenever from an organ-pipe we hear harmonics together with the fundamental, then the air-reed is vibrating to its fullest mplitude, for it is the superabundant vitality of the air-column that sustains the coexistent ones; but when we hear harmonics independent of the fundamental, then we may be sure that they are the expression of the higher activity of the reed itself, then working with lessened *amplitude* of motion, yet with greater *velocity* of vibration.

The genesis of these tones is due to the association of reed and pipe. Without the pipe the reed could not produce tone, would be barren as one sex. As the pipe is silent and requires some external impulses to bring it into life, so the air-reed needs something to act upon before it can vibrate or swerve from its course in minute degree; some inequality of environment is all it asks—some alliance with power distinct from its own. Take away the pipe, leave it only the mouth, and it will pull against that and begin to work according to its nature, and even in that rudimentary condition will elicit tone of definite pitch.

Many classes of organ-pipes give harmonics of the direct order without a trace of those of the inverse order; on the other hand, the several varieties of pipes which give the inverse order invariably yield the direct order subsequently with the ground tone; and why? It will be comprehended at once, if I have rendered my meaning clearly, that the initial harmonics proclaim the intense vigour of the reed, and that force, unabated in strength, although widened in scope, is transferred to the air-column of the pipes The difference of effects produced by the two orders constitute. that variety of quality which distinguishes string-tone from horn-tone, and a further modification chiefly in relative times of sequence asserts its peculiarity as reed-tone; yet, again, there are in both series departures from truth of pitch, in some qualities an over-flatness of one or more harmonics, and in some an over-sharpness. The blast of the trumpet combines both flat and sharp harmonics strongly. The *direct* order of harmonics may be likened to an ascending arpeggio coalescing into a chord—the *transitive* to a descending arpeggio, in some instances having intervals regularly defined, in others starting abruptly and with wayward intensity, and in other displays passing swiftly onward to the fulness of tone, imperceptibly blended as is the "portamento" glide of voice or string.

In all the "Geigens" and "Gambas" and similar organ-pipes mimaphonic of "stringy quality," the transitive harmonics are the true cause of their speciality. Numerous experiments prove this to the eye as well as to the ear. I shall be able to show that the "Gambas" are characterised also by an over-sharpness of these transitive harmonics, and this paper is a necessary introduction to my proposed examination of the mode in which the peculiar quality of tone is built up in this attractive class of pipes.

HERMANN SMITH

Can Land-Crabs Live under Water?

PERMIT me to inform Mr. J. C. Galton that the authority for my statement in the "Outlines of Physiology" is also derived from "some book or other;" and that this "turns out" to be the classical "Hist. Nat. des Crustacés" of Milne-Edwards, vol. ii. pp. 16, 18, with which perhaps your correspondent is unacquainted.

Milne-Edwards, in his turn, refers (p. 19) to those who have studied the land-crabs in the Antilles and on the South American coast, viz, Rochefort, Feuillée, Labat, and Brown. He elsewhere, also, treats the subject as a comparative anatomist and physiologist (Ann. des Sciences Nat.; Todd's "Cyclopædia").

Whether the land-crabs of the east differ in their habits from those of the west is of course open to inquiry; and also in what ways (either anatomically or physiologically) they differ; but the question is clearly not whether they can survive for a few hours under water, but whether practically they can live in that element or are at last asphyxiated in it.

10, Savile Row, Oct. 6 JOHN MARSHALL

Bright Meteors

AT 8.55 this evening a party of six observed a meteor in the constellation Aries, or below it, which emitted light sufficient to cast a bright gleam on the neighbouring trees. The body of the meteor shot rapidly along a course extending about 20°. It then seemed to explode suddenly, and its track was luminous for a short time. The granular *débris* of the meteor continued to pursue with very much retarded velocity a path slightly deflected from its former course: it continued to do so for several degrees and it was, I think, fully a minute after the explosion that several of us almost simultaneously exclaimed, "It is falling." It resembled the expiring light of one globe of a rocket charged with golden rain. The falling motion was very slow. I think it was visible for two minutes after the explosion, but though we tried more than once to consult our watches, the light was insufficient. HENRY H. HIGGINS

Rainhill, Oct. 11

AN exceedingly brilliant meteor was seen here about 8.50 on Sunday evening, which was so bright that it attracted general attention, the light from it being as strong as an unusually bright flash of lightning, but more white. On looking up I saw, near the zenith, a long almost straight and uninterrupted ribbon of light, somewhat pointed at the end towards the north-east. After watching it for some time and noticing that it retained its brilliancy, I began slowly counting, and counted up to twenty before there was any noticeable diminution of luminosity. The last portion visible was the end opposite the pointed end, which appeared as a faintly luminous patch as large as the apparent disc of the moon. I consider that, from its first appearance, it was visible from 80 to 100 seconds.

Wisbech, Oct. 11 A. BALDING

Rainbows

AS a supplement to the description of a "Double Rainbow," published by Prof. Tait in NATURE, vol. x. p. 437, the following diagram may be of interest to your readers. It represents a phenomenon which was seen here a few days ago, and one which I should think must be of very rare occurrence.

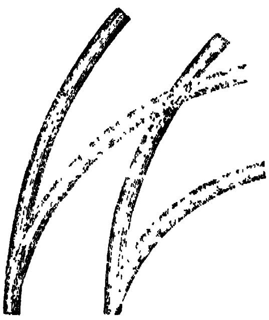

FIG. 1.

It will be observed that all the four bows were incomplete, but this only arose from the accidental cause mentioned by Prof. Tait. The two extra bows were due to reflection from a calm sea.

It may perhaps be remembered that about eighteen months ago I published in NATURE a verbal description of a rainbow similar to that now figured by Prof. Tait; only I was fortunate enough to see the bows complete and extraordinarily brilliant. Hence there were three bows, thus:—

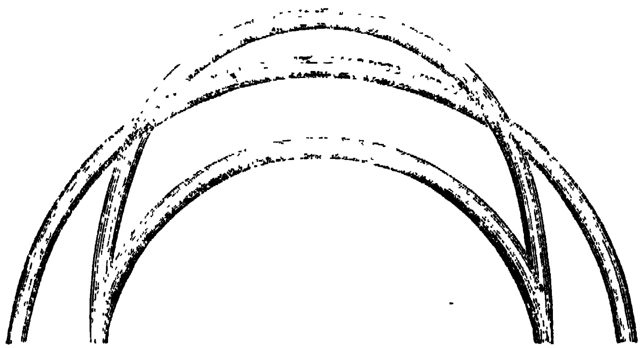

FIG. 2.

I presume that the presence of the fourth bow, as shown in the first diagram, is to be accounted for by the reflection from the sea having been sufficiently bright to give rise to a double concentric bow. GEORGE J. ROMANES

Dunskaith, Ross-shire, Oct. 3

IN reference to Mr. Tait's letter in NATURE, vol. x. p. 460, it may interest some of your readers to hear that our party saw a very perfect lunar rainbow at North Malvern, Worcestershire, on the evening of July 27, this year. The bow was so perfect that the colours were easily distinguishable—that is, of course, the main colours. The appearance lasted about five or ten minutes (10.35 to 10.45 P.M.) JOHN LATCHMORE, JUN.

Leicester, Oct. 12

The Cry of the Frog

WITH reference to the power of the frog to cry out, I may mention that while in India, as I was walking in my garden after dusk during the rainy season, when a peculiar kind of enormous green frog make their appearance for a few weeks, I was surprised to hear a cry exceedingly like that of a baby. On sending for a light I found a large frog, with a small one in its throat which it was apparently swallowing, while the small frog, the snout of which was just perceptible, was shrieking in the way I describe. On tapping the big frog sharply on the back, the little frog jumped out and made off.

Leamington, Oct. 10 J. P. G.

I HAVE on three different occasions heard a frog expostulate in the manner described by Mr. Mott. One did so on being patted inquisitively by a cat; the two others on being examined by a little dog. In each case the frog was of so unusually vivid a yellow as to suggest that it was either a variety of the common frog, or that it was in some unusual condition. Is Mr. Mott's frog equally brilliant? I may add that my three were also Leicestershire frogs. E. H.

Oct. 13

IT may interest your correspondent who has elicited what he believes to be a cry of fear from a frog, to know that an explanation of this cry—which is probably but the croaking experiment or *Quakversuch* of Goltz—is given at p. 201 of the recently issued volume of the West Riding Asylum Reports in the very remarkable paper by Dr. Lauder Brunton, on "Inhibition, Peripheral and Central." The extract is too long for quotation. H. W. P.

Oct. 13

I REMEMBER as a boy being rather startled by a shrill wailing cry which proceeded from a small pond, and on running to the spot I found a common snake in the act of swallowing a frog. They were on the surface of the water in the middle of the pool; the hinder part of the frog had already disappeared, and the terrified creature was crying piteously. He proved, however, too big a mouthful to be readily disposed of, and when by the aid of a long stick I interrupted the banquet and released him, he dived away apparently unhurt.

Though I have lived much in the country, I never heard a frog cry but on this occasion. I have often seen them played with, tumbled about, and patted by dogs and cats, as described by your correspondent F. T. Mott, but they have always borne the indignity in silence. F. BADEN BENGER

Manchester, Oct. 10

The Edible Frog

IT is stated in Bell's "History of British Reptiles," 2nd edit., p. 111, that the Edible Frog (*Rana esculenta*) was captured for the first time in this country in Foulmire Fen, Cambridgeshire, in 1843. Mr. Bell received some specimens which on comparison he identified as belonging to the continental species, he having at that time some living ones obtained from France. Mr. Bond, who had written to the *Zoologist* on this subject, said "the whole fen was quite in a charm with their song." Their very remarkable and sonorous croak had procured for these frogs the name of "Cambridgeshire nightingales."

I have recently been informed that this reptile was introduced from France some fifty years ago, and turned loose in the south of Cambridgeshire; and that very recently some one who is partial to the dish called "Frog-pie" has introduced the animal into Norfolk. But I cannot obtain any satisfactory information as to the naturalisation of the reptile. Are those brought into this country dying out? If not, they do not seem to have reached Norfolk, and I cannot find any in this neighbourhood. Is, then, the *Rana esculenta* to be regarded as a British reptile? If any of the readers of NATURE can inform me whether they have obtained it in the Fen district, I should be much obliged.

Wisbech, Oct. 9 SAML. H. MILLER

SOUNDINGS AND CURRENTS IN THE NORTH PACIFIC OCEAN

PREVIOUS accounts of the soundings of the U.S. steamer *Tuscarora* in the North Pacific Ocean, with reference to laying a cable between America and Japan, have described the work accomplished sailing from the Asiatic coast up to lat. 41° 09′ N., long. 144° 01′ E., after two projected routes had been tried and abandoned. From that point the *Tuscarora* went to Hakodadi to obtain a supply of coal, and thence sailed to lat. 46° 38′ N., long. 151° 47′ E., from which point soundings were taken on a backward line to the position which was left to go to Hakodadi; the backward line skirting the shores of the Kurile Islands. All the soundings are taken at intervals of 29 or 30 miles. Upon the new route thus surveyed from Yokohama, for a distance of 1,000 miles, the depths range from 300 to 2,270 fathoms, the greatest declivity being 161 ft. to the mile, between lat. 40° 10′ N., long. 142° 57′ E., and lat. 41° 09′ N., long. 144° 01′ E. The depth gradually increased between lat. 47° 44′ N., long. 154° 15′ E. and lat. 50° 19′ N., long. 159° 39′ E. (a distance of 260 miles), at the rate of about 60 ft. to the mile; the depth at the point last named being 3,754 fathoms. The course thence was through open water between the Kamschatkan coast and the Aleutian Islands; but just before entering the latter group the steepest declivity was found that has been met with during this survey. The preceding and succeeding coasts, each at a distance of 29 miles, gave depths of 2,460 fathoms, while this one, in lat. 52° 06′ N., long. 171° 15′ E., gave 4,037 fathoms, a slope of at least 326 ft. to the mile. Thence to lat. 51° 58′ N., long. 174° 31′ E. (about three miles from Atchka Island), the water shoaled to 332 fathoms, rising at the rate of 187 ft. to a mile. From the last-named position to Tanaga Island the depths ranged from 200 to 1,800 fathoms, including only one remarkable declivity, which was between lat. 51° 08′ N., long. 178° 35′ W., and lat. 51° 28′ N., long. 177° 57′ W., where the slope was 250 ft. to the mile.

Between Tanaga Island and Illiouk, a distance of about 500 miles, the depths nowhere exceeded 1,500 fathoms. The latter place will afford facilities as an intermediate station for the projected cable. Thence the course surveyed was to the north-east, afterward veering to the eastward through Ounimak Pass, toward the locality at which the survey proceeding from Cape Flattery westward left off last autumn, lat. 53° 58′ N., long. 153° W. From Illiouk to lat. 54° 10′ N., long. 162° 39′ W., the depths were small, being at the latter point 44 fathoms. Thence to lat. 54° N., long. 158° 22′ W., a distance of 151 miles, there was a descent of 130 ft. to the mile, the depth at the last-named being 3,359 fathoms. From this point the bed rises, reaching about the same level as that of last autumn's stopping-place—2,520 to 2,530 fathoms—when within 30 miles of that location. The great depth of 3,359 fathoms can be avoided by selecting a line some 30 miles to the northward, where only 2,900 fathoms' depth is found. A series of observations south of the line already surveyed gave greater depths.

Numerous observations were made on currents and temperatures. Along the shores of Kamschatka and the Kurile Islands, in lat. 51° 39′ N., there is a counter-current setting to the south-west, extending to long. 164° E., with a surface temperature of 42° F. Thence to long. 174° E. in the same latitude, with a surface temperature of 46° to 47° F., is the Kamschatka current (a branch of the Japan stream, setting through Behring Straits), which is here about 350 miles in width. It lost 22° F. between the Japan coast and lat. 51° 39′ N. The counter-current within the same limits gained 6° F. The atmosphere lost 18° F. From long. 174° E., proceeding eastward, the cold Behring Straits current with about 42° surface temperature was found, having for its western limits St. Lawrence and St. Matthew Islands. It is inferred that the counter-current of long. 164° is part of the Behring Strait current, having the same temperature, and that it flows beneath the Kamschatka current; and this belief was confirmed by finding at 30 fathoms' depth and below the latter current one setting to the south-west. On this

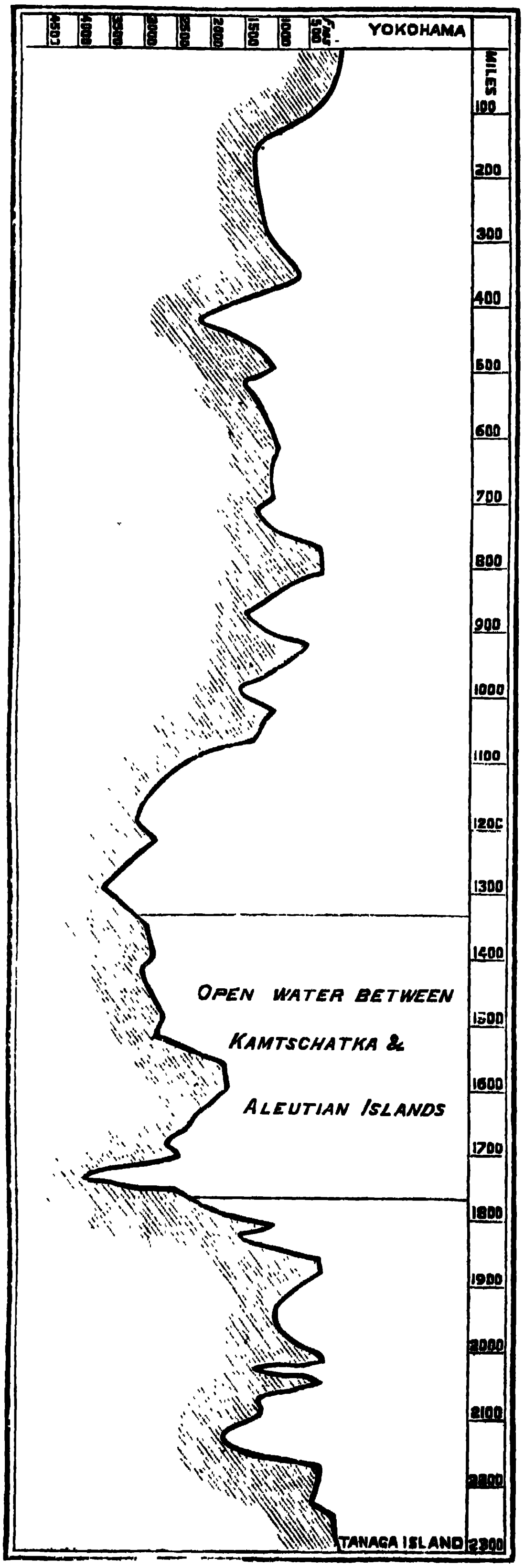

FIG. 1.—Bed of the Pacific from Yokohama to Tanaga Island.

theory the excess of loss of heat on the part of the Kamschatka current over that of the atmosphere, as stated above, may be explained by attributing it to the cooling effect of the counter-current beneath. It may here be mentioned that the northernmost limit of the Japan stream was 51° 12′ N., long. 178° 20′ E.

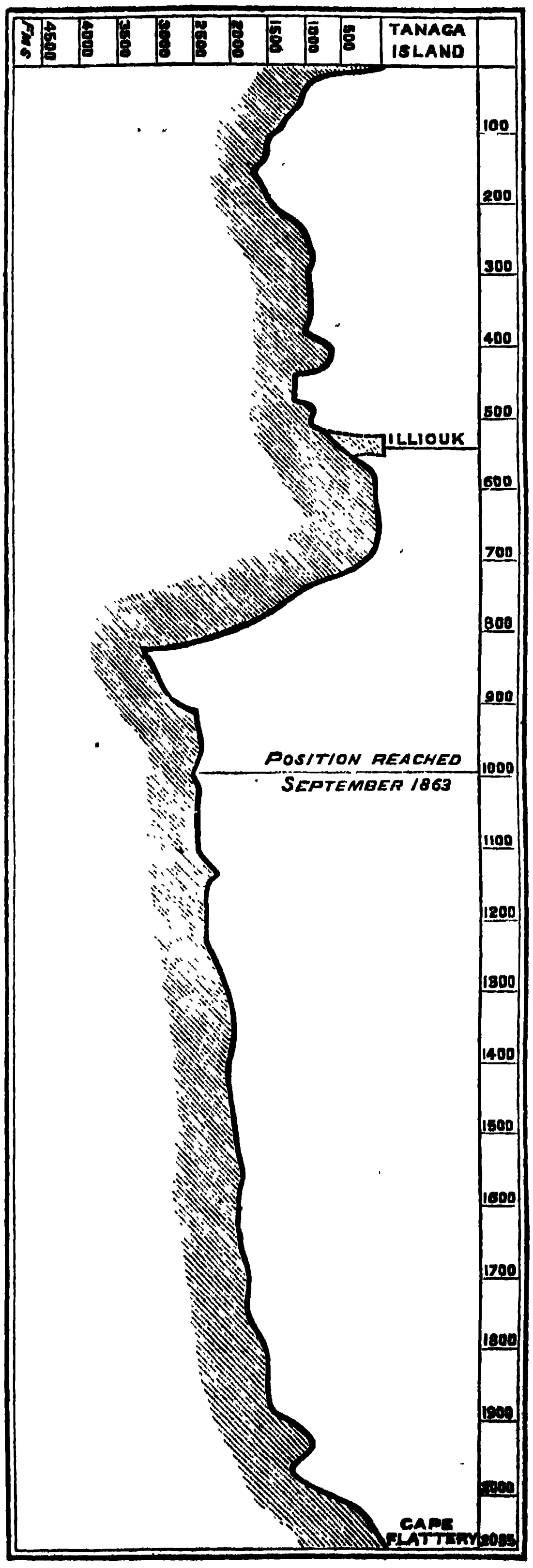

FIG. 2.—Bed of the Pacific, Tanaga Island to Cape Flattery.

The coincidence of observations on temperatures and currents was very noteworthy. There was found, for instance, at lat. 42° 51′ N., long. 148° 14′ E., a north-east surface current of a half-knot per hour; at 5 to 15 fathoms' depth the temperature was 40·3° F., and in this space the current was marked. In the next 5 fathoms the thermometer fell 6°, and correspondingly the current ceased to be observable at this 20 fathoms' depth. At 200 fathoms a steadily increasing current to the south-west was observed; while from 20 fathoms' depth all the way to the bottom—upward of 4,000 fathoms—the fall of temperature was only 1°. A cold stratum of water was discovered, coming down from Behring Straits as an under-current. Between lats. 51° and 52° and longs. 159° and 169°, this current is at 150 ft. below the surface, and itself of 400 ft. depth. It was perceptible at lat. 42° 47′ N., long. 148° 23 E., but south of that it disappears: lat. 51° 22′ N., long. 162° 20′ E. is believed to be nearly its centre. Now, at the last-named location, at 22 fathoms, the thermometer marked 35·7°; at 75 fathoms, 32°; at 100 fathoms, 35·5°. This current was again satisfactorily defined at lat. 51° 43′ N., long. 165° 25′ E., and there the temperatures were, at 25 fathoms, 37·7°; at 60 fathoms, 34·7°; at 100 fathoms, 37·7°. The bottom temperatures vary from 32° to 33·9°.

Reviewing the results of the entire investigation in respect to currents, the following deductions may be summarised:—The Kuro Siwa or Japan current extends on an easterly course toward the American coast, its northern limit nearly reaching the southern shores of Vancouver Island; and it passes down to the southward in what has been incorrectly denominated the "California cold current." Beneath this an under-current sets to the north-west, and in lat. 50° reaches the surface, after which it sets northward along the shores of British America and the outstanding islands, thence gradually turns to the westward, its direction being affected by the outline of the coast, and exhibits at Sitka a strength of one knot per hour and a northward flow. In lat. 53° 30′ N., long. 157° W., the current, to a depth of 5 fathoms, set to the south-east, and this continued while observations were made during sailing to the south-east; but between that position and the line of the islands the current was to the south-west, and close to the islands to the westward. It is believed that a part of the water carried to the north-west by the under-current, returns in long. 157° to the northern portion of the Japan stream, and mingles with it, returning to the southward along the western shores of America, as part of the surface current; and that the part to the westward of long. 157° which sets toward the south-west, passes as an under-current beneath the Japan stream. A rapid fall in temperature—from 57° to 47° in a few miles—in the Ounimak Pass, shows that the north-west shores of the Aleutian Islands are washed by the cold Behring Straits current, which is somewhat modified in temperature by the inflow of part of the westerly current from the eastward of the islands.

Many observations were made which indicated the relation of prevailing winds to surface currents. The material obtained from the sea bottom off the Kurile Islands had, in addition to the usual ooze, greyish-black sand, gravel, and lumps of lava. Similar sand and gravel were found, and also sponge, in the neighbourhood of the Aleutian Islands. The northern route for a telegraph cable, as finally indicated by this survey, is 4,200 miles in length; the southern, about 6,000 miles. The former route will present great though probably not insuperable difficulties, such as that of the sudden declivity off the Aleutian Islands, the frequent fogs which made even the survey tedious, the embarrassments incident to a northern region, where there are few of the means provided on more civilised shores to meet the requirements of working parties and occasional repairs. The chief merits of the northern route are its comparative shortness and its propinquity to United States territory.

NATURAL HISTORY NOTES FROM SOUTH AFRICA

MR. J. P. MANSELL, of Brooklyn, near King William's Town, Kaffraria, has sent us the following notes, the results of his own observation in the district in which he dwells :—

In November 1869 I was looking for some louries in the Bedford forest. My gun was loaded with a very small charge of dust shot. A large troop of monkeys was disturbing my birds, and, annoyed with them, I fired among them at random. One fell on the branches of a bush, shrieking piteously. I ran up to put the poor thing out of its agony, when to my great surprise I saw the whole troop (about twenty) rushing down the trees and screaming savagely. They came so close to me that I had some trouble in killing the wounded one, as I was afraid they would attack me. Were monkeys substituted for toucans in the frontispiece to Mr. Bates's Travels, the scene would be almost identical.

A few days ago, while working in my garden, my attention was drawn to a part of the kloof by the angry screams of birds, indicating a snake. On approaching the spot where the birds were collected, I noticed several dashing at a low shrub. As I approached the dark underwood an Ahætulla, whose characters do not agree with any published description, rushed out. I struck it with a spade, and then, curious to see how the birds would act, I flung it half alive over a branch of a tree, still holding it by the tail.

There were a great many bush birds, but especially noticeable were *Turdus olivaceus* and a Campephaga.

The first-mentioned birds kept flying round in a wide circle, dashing with open wing and beak at the snake, and screaming with the utmost fury. With such violence did these birds dash at their enemy, that more than once the bird fell on the ground from the branch against which it struck. The birds continued attacking the snake for some minutes.

While at the Koonap in 1865 I saw the common *Juida phœnicoptera*, which had a nest in the trunk of an Euphorbia, screaming with fury, and attacking boldly a red mierkatje, which was endeavouring to plunder its nest.

We have heard so much of the mysteries of fascination, &c., that I think a comparison of the cases I have given, together with the well-known way in which birds pursue owls, cats, and cuckoos, shows that it is more fear than anger which gives the subtle snake an easy prey, than any mysterious mesmeric influence; and I believe the immunity of the mongoose from the poison is owing to its closely-pressed, tight, wiry hair.

The wattles of turkey-cocks are a decided disadvantage to them in a warm country like this. I have lost two from the flies laying their eggs in the wounds inflicted by rival birds.

Some four or five years ago, when in Fort Beaufort, a friend of mine amused me by bringing a stuffed leopard to a pet monkey he had. The monkey would scream with terror, shut its eyes, and hide away in my friend's coat. On touching it with the claws its terror was piteous. On removing the leopard it would slowly peep out, and on catching sight of it close its eyes tight.

I do not think it is generally known that baboons in Karoo districts, such as Richmond and Hopetown, destroy in dry seasons numbers of lambs. A farmer told me that they were more destructive than any other wild animal in the district.

There are likewise two varieties of the leopard called respectively Berg and Rivière Tiger, from frequenting mountains or rivers; and the baboons are said to vary according to their locality. It is said that baboons will kill a leopard. A friend of mine at the Koonap had a tame baboon which shouldered arms and wrapped itself in a sheepskin like a Kafir.

South African Birds which eat Butterflies.—As some doubt was thrown on this subject in your journal a year ago, I now give the result of a year's careful observation, and I have little doubt the number could be greatly increased. *Cypselus caffer* eats *Pieris hellica* and *Terias rahel*, also numerous small Heterocera.

Zosterops capensis eats Pieridæ and small moths. On April 30, 1871, I saw a pair trying to capture a butterfly, which very cleverly eluded them.

Motacilla capensis—Pieridæ and moths, but prefers flies and bees.

Anthus capensis—*Pieris hellica* and *P. charina*.

Oriolus capensis—*Pieris charina* and *P. gidica* or *P. severina*.

Tchitrea cristata—*Pieris agathina* and other Pieridæ, and, I think, other butterflies too, but am not certain.

Dicrurus musicus. I saw this bird dart at and capture last year so large and rapid a butterfly as *Philogroma varanes*; it also destroys Pieridæ.

Lanius collaris. I have seen this bird take butterflies, but do not know whether it is in sport or for food.

The above instances are from actual observation, made in some cases more than once.

Migrations of Insects and Plants.—I have especially remarked, since my attention was drawn to it, how few conspicuously coloured and hairy caterpillars are attacked by birds. Some of these conspicuous caterpillars, on being touched, eject a nauseous liquid in large quantities; this is especially the case with *Antherea tyrrhea*, the larva of which every year strips my thorn trees (*Acacia horrida*) quite bare. The eggs are large, enclosed in a hard, bluish white shell, and fastened in large clusters at the end of branches. They appear to be never destroyed by animals.

The moth generally issues in abundance after the first heavy warm rains of September or October, and is seldom to be found after a week. This is also the case with several allied moths. Hundreds may then be seen like small bats, and the next morning the ground is often strewed with their fragments, as they appear to be highly attractive to nocturnal birds. The larva is often attacked by ichneumons, but still the quantity is unappreciably diminished, and hundreds may be seen travelling from tree to tree. They are more numerous in wet than dry seasons.

We have had this year some remarkable visitations of Pieridæ. In October, November, and December I have seen enormous swarms, principally composed of *Pieris charina, severina, gidica*, and *hellica*. The early part of the summer was very cool, but just before Christmas and at present the heat has been most oppressive. On December 24, I found the shady inside of the kloof alive with *Pieris agathina*, in all the varieties, as far as I could judge, principally males. This butterfly is usually abundant in September, but I had observed only a few specimens in the early summer.

I tried to make a calculation as to their numbers, and selected a damp spot where most of the insects had settled. I counted on a spot about three yards square about fifty; many were hidden by stones and leaves. They were about equally abundant in other parts of the kloof, and I think, therefore, that fifty would be a fair average. As the kloof is 500 yards long, or thereabouts, and in some parts thirty yards broad, I think the following calculation (allowing for the extra attractiveness of the moist spot observed), namely, twice the quantity, calculated at three yards broad, would give a quantity of 16,666 for the entire kloof. The kloof was full of birds chasing these insects, and two days later the number was greatly diminished.

As far as my observations go, I am led to believe that there are three kinds of migrations among butterflies. The principal relates, for the most part to Pieridæ, such as *Pieris hellica, gidica, severina, mesentina*, and *Colius electra*. These butterflies seem to be attracted to cultivated ground, old kraals, or cleared forest. On all these spots vast numbers of weeds—many introduced plants—spring up, and appear to be particularly attractive to these insects. These migrations take place as often against as with the wind.

Papilio merope, *Philogroma varanes*, *Pieris eriphia*, *Pieris zochalia*, and *Terias rahel* appear to migrate in the direction of the wind, and there are one or two others which perhaps do so also, such as *Junonia pelasgis*. When resident at Bedford I never saw these butterflies in seasons of drought, but so soon as the southerly winds with rain became abundant a few stragglers might be met with.

P. gidica, *mesentina*, and *severina* likewise share in these southerly and northerly migrations.

Lastly, there are the sudden and almost inexplicable appearance and disappearance of certain species, such as *Callidryas rhadia*, *Diadema misippus*, &c., although I see Mr. Bowker mentions having seen vast swarms of the former in the Drakensberg taking a south-easterly course. During the last two years I have hardly seen a specimen of these two butterflies. The year before they were most abundant. I would here remark that I do not remember to have noticed in any entomological work, although the shapes of butterfly wings are accurately described, an account of their peculiar and finely graduated modes of flight.

Thus, in Pieridæ, *P. hellica* flies generally in open ground from flower to flower, but alternately rises and falls and shifts from side to side. *Terias rahel* has a similar flight, but slightly more direct; *Colias electra* a similar flight, but I think a trifle swifter.

Cypselus caffer, which preys on these, generally describes semicircles, flying backwards and forwards over the grass in the manner of a scythe working, and it is curious to see how artfully these butterflies, by a slightly higher or lower flight, escape their much swifter winged enemy.

The different varieties of *P. agathina* in like manner vary. The whiter specimens (♂) frequent more the open, and are a trifle swifter in their flight than the gamboge and ochreous varieties, or their ♀. The latter frequent wooded spots, and rise and fall through the foliage like dead leaves, and it is surprising to see how with sluggish movements a slight change of direction saves their lives. *P. gidica*, *mesentina*, *severina*, and *zochalia* in like manner vary among themselves in their varieties and in different localities.

I was particularly struck, when on a visit to Cradock in 1867, by the difference of size and colour and flight in *Mesentinas* in the Karoo from that of those in the Bedford Forest.

Papilio cenea, which my observations confirm as being the female of *merope*, as so admirably indicated by Mr. Trimen, changes its flight in a remarkable manner when quitting the forest for the open plain. In the forest its flight is remarkably weak, especially if contrasted with that of its mate; whereas over open plains it rapidly rises out of sight, and soars away like some bird of prey with scarce a flutter of the wing.

Junonia pelasgis, *archesia*, and *amestris* are in like manner very similar in their flight, but differ with the difference of the localities they frequent; *J. archesia* being intermediate between the forest-frequenting *J. pelasgis* and the plain-loving *J. amestris*. It is also remarkable that where *J. archesia* frequents the same spots as *J. pelasgis*, its markings approach that species; where it delights in open country, about Kaffraria, it is bluer, and slightly more like *J. amestris*.

Nymphalis xiphares.—The ♀ of this species is much weaker in its flight than the male, and its coloration, as is known, differs remarkably. Last year I captured it in company with *P. merope* and ♀ *P. echerioides*, and was much struck at the time by the similarity of colour and pattern, although its imitation is much coarser than that of the other two butterflies.

A long series of ♂ and ♀ *Meropes* shows a remarkable variation, hardly two specimens being alike, and in one ♂ a small oblong black spot closes the discoidal cell of the fore-wing.

On some occasions plants of different orders seem suddenly to increase and then almost disappear for a season or so. This is notably the case with some Compositæ.

As I mentioned in a letter to Mr. Darwin, two species of Gramineæ, *Tragus alienus* and *Briza geniculata*, appear to spring up in the course of locust swarms. I at first was rather sceptical on this subject, but by carefully watching the locusts and examining *sour veld*, where these grasses do not generally grow, I believe that the opinion of the farmer who first called my attention to it is correct.

Mr. Darwin, I believe, raised plants from locust dung which I sent him, but I am not aware to what species they belonged.*

JEFFRIES WYMAN, M.D.

IN the death, on the 4th ult., at Bethlehem, N.H., of Prof. Jeffries Wyman, American biological science has lost one of its most able comparative anatomists. Prof. Wyman was born on Aug. 11, 1814, at Chelmsford, Massachusetts, and had therefore just completed his sixtieth year. His father was a well-known physician. He graduated in Arts at Harvard University in 1833, whereupon he commenced his medical education, and took his degree in 1837, after which he for two years continued his studies in Paris. Returning to Boston he became for some time curator of the Lowell Institute, where he commenced his career as a teacher by delivering two courses of lectures on comparative anatomy and physiology, in which he first gave indications of the lucid and well-ordered expository powers which throughout his life made him so great a favourite with all hard-working students. In 1844 he became Professor of Anatomy and Physiology in the Medical School of Richmond, Virginia, in connection with the Hamden-Sidney College. In 1847 he succeeded Dr. Warren as Professor of Anatomy in Harvard University; at which time, from the materials brought from Africa by Dr. Savage, he had the earliest opportunity of describing that naturalist's new genus of anthropoid apes, the Gorilla (*Troglodytes gorilla*, Savage). This professorship he held till 1866, and it is to him that Cambridge, Mass., almost entirely owes the development of its excellent Museum of Comparative Anatomy.

Prof. Wyman had for many years been a sufferer from phthisis, which necessitated his removing to the warmer climate of Florida during the winter months, and the cessation of his lectures and practical work. When the Peabody Museum of American Archæology and Ethnology was established, the founder appointed Prof. Wyman one of his trustees, and the board committed the incipient museum to his charge and direction. The seventh annual report of this institution, just issued, was his last production. Most of his written contributions to science are contained in the Journal and Proceedings of the Boston Natural History Society, of which for many years he was the president; and in the "Smithsonian Contributions to Knowledge."

Prof. Wyman was a man of singular modesty and truthfulness. His bad health was always in the way of his will to work; and his desire of completely mastering whatever he undertook, together with a certain over-cautiousness, has limited the number of his works. It is not remembered that he ever had a controversy. In his death a gap has been caused which it will be difficult to fill.

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* See "Origin of Species," 6th ed., p. 327

LECTURES IN NATURAL SCIENCES AT CAMBRIDGE

THE following lectures in Natural Science will be given at Trinity, St. John's, Christ's, and Sidney Sussex Colleges, during Michaelmas Term 1874.

On Electricity and Magnetism.—By Mr. Trotter, Trinity College, in Lecture Room No. 11. (Mondays, Wednesdays, Fridays, at 11, commencing Friday, Oct. 16.) Students desiring to attend this course are requested to call upon Mr. Trotter at his rooms on or before Thursday, Oct. 15. Students of Colleges other than Trinity, St. John's, Christ's, and Sidney, can be admitted on payment of a fee of 1*l.* 1*s.*

On Elementary Organic Chemistry.—By Mr. Main, St. John's College. (Tuesdays, Thursdays, Saturdays, at 12, in St. John's College Laboratory, commencing Tuesday, Oct. 20.) Instruction in Practical Chemistry will also be given. Students desiring this instruction are requested to call upon Mr. Main on or before Monday, Oct. 19. For members of Trinity, St. John's, Christ's, and Sidney, the fee for the lectures in Chemistry is 10*s.* 6*d.*, and for instruction in Practical Chemistry 1*l.* 1*s.* per term; for others the fees are respectively 1*l.* 1*s.* and 2*l.* 2*s.* per term.

On Palæontology.—(The Protozoa and Cœlenterata.) By Mr. Bonney, St. John's College. (Tuesdays and Thursdays, at 9, commencing Thursday, Oct. 15.)

On Geology.—(For the Natural Sciences Tripos. Preliminary matter and Petrology.) By Mr. Bonney, St. John's College. (Mondays, Wednesdays, and Fridays, at 10, commencing Wednesday, Oct. 14.) A course on Physical Geology will be given in the Lent Term, and on Stratigraphical Geology in the Easter Term. Papers will be given to Questionists every Saturday at 11, but the first paper will be set on Wednesday, Oct. 14, at 11, when arrangements will be made for further instruction, should it be required. Students desiring to attend any of these courses are requested to call upon Mr. Bonney on or before Wednesday, Oct. 14. Students of other Colleges can be admitted to these lectures on payment of a fee of 1*l.* 1*s.* for the course. An Elementary Course will be given in the Lent and Easter Terms.

On Vegetable Morphology.—(For the Natural Sciences Tripos.) By Mr. Hicks, Sidney College. (Tuesdays, Thursdays, and Saturdays, at 11, in the Taylor Lecture Room, beginning on Tuesday, Nov. 3) The lectures during this term will be on the Morphology of Phanerogamia. For members of the above Colleges the fee for this course is 1*l.* 1*s.*; for others 2*l.* 2*s.*

A Course of Practical Physiology and Histology.—By the Trinity Prælector in Physiology (Dr. Michael Foster) at the New Museums. Lectures on Tuesdays, Thursdays, and Saturdays, at 10, commencing Tuesday, Oct. 20. Fees for the Practical Class, 3*l.* 3*s.*; for the course of two terms, 5*l.* 5*s.* This course is intended for those who have gone through a course of Elementary Biology similar to that given last Easter Term.

Also a short course of lectures on the *Physiology of Nutrition*, on Wednesdays, at 10, commencing Oct. 21.

On the Comparative Anatomy of Invertebrata.—By Mr. Martin, Christ's College. (Mondays, Wednesdays, and Fridays, at 12, commencing Friday, Oct. 16.)

NOTES

AMONG the Fellowships at Trinity College, Cambridge, awarded on Saturday last, one was given for proficiency in Natural Science. Although thrown open to the whole University, it was gained by a member of Trinity College, Mr. Francis M. Balfour, B.A., the circumstances of whose election are worthy of notice. The Fellowships at Trinity College are awarded according to the results of an examination held specially for the purpose, and not as in other Colleges, according to the positions gained by the candidates in the University Examinations or Triposes. The Natural Science Fellowship was no exception to this custom: a special examination in Physics, Chemistry, and Biology, was held in order to test the proficiency of the candidates. But it had previously been announced that the examiners were prepared in estimating the proficiency of the candidates to take into consideration records of original work in the shape of published memoirs or unpublished dissertations, and to be guided by the value of these as well as by the ordinary examination answers. In other words, the authorities of Trinity College formally declared that they were prepared to bestow a Fellowship *as a reward for, and thus as an encouragement to, research.* Mr. Balfour's success in his candidature was, we understand, due to the value attached to the original memoirs, chiefly on embryological subjects, sent in by him, as well for their actual worth as for the future of which they gave promise. We congratulate him and the Natural Science School at Cambridge on the result. The deadening influence of the examination system at Cambridge, great as it is in mathematics, bears with fearful effect on all Natural Science studies. The cramming necessary for success in a competitive examination such as the Natural Science Tripos, renders original research for the time being impossible, and goes far to destroy all power for it in the future. Mr. Balfour had the courage to commence original work before he had taken his degree. In spite of warnings that he was endangering his position in the Tripos, he chose the better part, and spent in research the time he might have frittered away in cramming for an examination. Incidentally he has thereby won a Fellowship. We trust that his example will be followed by other students, and the example of Trinity College by other Colleges, so that henceforward on the one hand early research may be the rule at Cambridge instead of the exception, and on the other the injurious effects of the Fellowship system may be lessened as much as possible.

THE following changes are proposed to be made in the Council of the Mathematical Society for the ensuing session:—Dr. Hirst, F.R.S., the retiring president, will become a vice-president, and be succeeded by Prof. H. J. Stephen Smith, F.R.S. Mr. Spottiswoode, F.R.S., having served his term of office as vice-president, will become an ordinary member of the Council. The vacancies caused by the retirement of Prof. Henrici, F.R.S., and Mr. J. J. Walker, have been filled up by the selection of Mr. R. B. Hayward and Mr. W. D. Niven. The Society has nearly completed its tenth year, and has had as presidents De Morgan, Sylvester, Cayley, Spottiswoode, and Hirst. It would, we think, be difficult to find more fitting representatives of the mathematical ability of this country, should the day ever arrive, in this day of congresses, for holding an International Congress of Mathematicians. When the Society started into existence on Jan. 16, 1865, there were, we believe, not more than two similar societies in the world; now, each year adds to the ever-lengthening chain. It is a singular and sad coincidence that as the present president on his accession to the chair had to announce to the members the great loss the Society had sustained through the death of the lamented Dr. Clebsch, so, too, as he vacates his office will it be his last task to tell of the decease of Dr. Otto Hesse; though in this sad case mathematicians have to mourn the loss of a man full of years and honours. The Society is thus left without a representative of the great body of German mathematicians in its list of foreign members. The election of the new Council will take place on Nov. 12. The above-named changes are those suggested by the present Council, and will be submitted in the usual way to all the members of the Society for their approval.

ANOTHER College for Working Women is about to be opened. Its inaugural meeting is announced for Friday evening, at No. 5, Fitzroy Street, Fitzroy Square. The committee aims at enabling women who can spare a few evenings a week to obtain gradually a liberal education. The fees are very low, and the classes numerous. A library and a coffee and conversation room will, it is hoped, promote friendly intercourse amongst the members. Many have promised to teach or occasionally lecture, amongst whom we see the names of Mr. J. G. Fitch, Mr. Thos. Hughes, Q.C. (Principal of the Working Men's College), Mr. Litchfield, Prof. Seeley, Mr. George Macdonald, Miss Chessar, Miss Keary, and Dr. Morell.

IN connection with the *conversazione* held at the opening of Owens College, Manchester, there was an interesting loan collection brought together through the energy of Mr. W. B. Dawkins and Mr. R. D. Darbishire. A large series of plants of the coal measures was exhibited, with specimens of the nearest known living representatives systematically placed among them to convey an idea of the kind of vegetation from which coal was formed. Near these was a geological model of a boring for coal. A quaint set of stone mining tools from the abandoned workings of the Alderley Edge copper mines, and wooden and iron tools found in Derbyshire, were of especial interest. The local geology was well illustrated, and there was a fine collection of fossil bones which have been recently discovered in a fissure at Windy Knoll, near Castleton, by Mr. Pennington. A well-supported endeavour was made to illustrate the latest stage of vertebrate life in England as known by the remains found in bone caves and river deposits; and an extensive collection of mammoth, bear, lion, and other bones was the result. Near these were cases containing early implements fashioned by man. A Manchester paper says of these cases: they "include all the evidence as to the antiquity of man given by both river and cave, and we need little scientific assistance to find out that these constitute the most complete set of stone implements ever got together. To make their evidence clearer, illustrated and explanatory diagrams are placed near them. . . . The collection of neolithic flints is wonderfully complete. A case sent by Mr. John Evans carries us from the rough model to the same instrument more exquisitely finished and moulded."

THERE is hope for scientific education when a sporting correspondent of the *Field* discourses on it. The gentleman in question has recently visited the Mining Academy of Freiberg, which he thus describes:—"Students of every nationality are found here, and there is no doubt that if a man likes to work he can learn a great deal, as some of the most celebrated professors in Germany are teachers. The only requisite for a student entering the Academy is that he should know a little German. This rule is not very strictly observed, and anyone of ordinary intelligence ought to pick up the requisite amount in a month, or six weeks at the outside. There are different courses open to the option of the student, such as an assaying course, chemical course, surveying and mining course, &c. These are each charged separately for, the fees ranging from 3*l.* to 5*l.* each. The blow-pipe course, given by the famous Prof. Richter, is 6*l.* Foreign students are charged 5*l.* yearly extra; German students are exempt from this tax. Living in Freiberg is excessively cheap. The whole course lasts three years, but I imagine that a man would do far better by picking out a few particular lectures and finishing in eighteen months or two years. Now, after the course, what return has a man for his money? I unhesitatingly answer that a man who has worked hard for two years at Freiberg ought to be able to go anywhere in any mining district in the world and command his 500*l.* a year. So many people are troubled with questions as to what to do with their younger sons, that I am sure that sending them to Freiberg, and giving them a first-class profession in two years for 375*l.* or 400*l.*, is well worth their consideration. To such a man, *i.e.*, one well educated at Freiberg, the whole of the American continent, and, indeed, most of the world is open. Now that England is so 'blocked' it has become a necessity to go further afield, and probably mining engineering and assaying offer about the very best openings to an enterprising man. Immense deposits of metal are daily being discovered in Colorado and the south-western States, while Chili and Peru are short-handed." The sporting correspondent is correct as far as he goes, and it is perfectly true that many young Englishmen have gone to Freiberg, but he does not seem to know that the British Government has just fitted up a small cellar in Jermyn Street, and that with such a national metallurgical laboratory as this, of which of course the country should be justly proud, there is no fear that more young Englishmen will seek to perfect their studies in a foreign land.

FROM a paper on "Some indigenous Tuscan Remedies," read by Mr. H. Groves before the recent Pharmaceutical Conference, it would seem that plants furnish a considerable portion of the medicinal products in use in that country. Many of the plants enumerated are well known as medicinal plants in other parts of Europe. The Chamomile (*Matricaria chamomilla*), for instance, is said to be found in the cupboard of every housewife, being used as a calming antispasmodic, and also applied hot externally for relieving pain. A custom very prevalent in Tuscany seems to be the administration of herb-juice in spring, which is prepared daily by many herbalists, and is also ordered by medical men. *Nasturtium officinale*, known as Crescione, is used in conjunction with *Cochlearia officinalis* in the composition of herb-juice. This latter plant, though indigenous, is also cultivated to some extent. The flowers of the Wallflower (*Cheiranthus cheiri*), under the name of *Viole gialle*, or Yellow Violets, are boiled in olive oil and used for enemata. With regard to products other than plants, the writer remarks that viper-broth is gone out of fashion, and the pharmacist is spared keeping those reptiles and the pincers with which they were handled. Snail poultices are still used in the country. The snails are applied alive, the shell being crushed or partly removed, and the snails set upside down on a piece of coarse paper; they are then sprinkled with a little vinegar and applied at once to the soles of the feet, on which they produce an irritation greater than mustard, and which is supposed to be efficacious in some cases of fever.

THE British Association partook this year somewhat of the nature of a Church Congress; the real Church Congress has, *en revanche*, partaken somewhat of a British Association meeting, Prof. Pritchard having communicated a paper to it giving his view of certain conclusions to be drawn from our present knowledge of molecules, and quoting in support of it the honoured names of Herschel and Clerk-Maxwell. As we are informed that the paper will be published *in extenso* elsewhere, we need not refer to it at any length here; but there is one bit of it which, coming from a clergyman and a professor at Oxford, we cannot refrain from quoting. He suggests that it would be a good thing "if in the study of every manse throughout England there were found a well-used microscope, and on the lawn a tolerable telescope; and, best of all, if those who possess influence in our national universities could see their way to the enforcement of a small modicum of the practical knowledge of common things on the minds of those who are to go forth and do battle with the ignorance and failings of our population, and to spread light throughout the land. A little knowledge of the ancient elements, fire, air, earth, and water, would save many a young clergyman from the vanity of ridiculous extremes, and from the surprise of the more wisely and widely educated among his flock." Surely no one will think that with regard to the Universities Prof. Pritchard is asking too much! He then goes on: "Depend upon it, whatever may be our suspicions or our fears, the pursuit of the knowledge of the works of nature will increase, and increase with an accelerated velocity; and if our clergy decline to keep pace with it, and to direct it into wholesome channels, they and their flocks will be overtaken, though from opposite directions, by the inevitable Nemesis of disproportion."

A SEVENTH edition of "The London Catalogue of British Plants" has just been issued. The chief differences between this and the preceding edition is in a renumbering of the specific names, and in those changes of technical arrangement which have now rendered it necessary to abandon the original series of numbers. The first edition of 1844 was closely adapted to the "British Flora" of the late Sir Wm. Hooker. This seventh edition is made to correspond with the "English Botany" of Dr. Boswell-Syme, third edition, as far as to the grasses. For the ferns and allied orders, the arrangement and nomenclature of Dr. Hooker's "Student's Flora" are closely followed. The species of Chara are taken from Prof. Babington's "Manual of British Botany." Mr. Backhouse is followed in the species of Hieracium; Prof. Babington in the Rubi; Mr. Baker in Wild Roses.

THE *Gardener's Chronicle* quotes from the *Illustration Horticole* that the recent International Botanical Exhibition at Florence yielded a net profit of 1,000*l.*, and that the disposal of this sum to the best advantage of horticulture is under consideration.

A SCHOOL of Mines has been established by the Territorial Government at Golden, Colorado, one of the best places in the country for practical instruction.

THE Sixth Annual Report on the noxious, beneficial, and other insects of the State of Missouri has been issued.

MR. EDWARD BELLAMY, of the Charing Cross Hospital, has been appointed to deliver the course of lectures on the Anatomy of the Human Form, at the South Kensington Museum.

"ELEMENTARY Astronomy, or Notes and Questions on the Stars and Solar System" (Van Voorst), a small text-book for the use of schools, by C. C. Keeks, contains a great deal of recent and accurate information in small space, and seems calculated to serve the purpose for which it is intended.

THE additions to the Zoological Society's Gardens during the past week include an Australian Rail (*Rallus pectoralis*) from New Holland, presented by Mr. J. Harris; a Gannet (*Sula bassana*), European, presented by Mr. R. R. B. Norman; a White-winged Trumpeter (*Psophia leucoptera*) from S. America; a Dusky Monkey (*Semnopithecus obscurus*) from Malacca; a Pinche Monkey (*Midas œdipus*) from New Granada; a Bonnet Monkey (*Macacus radiatus*) from India, deposited.

ON THE NECESSITY FOR PLACING PHYSICAL METEOROLOGY ON A RATIONAL BASIS.[*]

I WISH at the outset pointedly to disclaim originality in the main ideas to which I propose here to invite attention. The subject of my paper has occupied the thoughts of many men of science, with some of whom I have been in communication regarding it for several years. But though the conclusions to which I wish to lead you are the product of many minds, I am bound to accept to the fullest extent the self-imposed responsibility of bringing them forward at the present time and in the present form.

The branch of inquiry which has been very unsignificantly named Meteorology (meteoric phenomena being but slightly and remotely included in it) deals with the climate of the globe, and seeks to explain the vicissitudes of temperature and moisture, storm and calm, to which that globe is exposed. It is a subject of the highest importance to mankind generally, as affecting health, navigation, and agriculture; and possesses an interest acknowledged by every individual, from the savage to the *savant*, influencing as it does the personal well-being and daily comfort of all. Everyone discusses, and thinks himself competent to discuss, the weather.

My present object necessitates a broad classification of this department of inquiry into two main branches. The more obvious one of these, for which a fitting name has yet to be proposed, relates to changes of weather from day to day, and to the varieties of climate found in different localities. I shall not say much on this branch of Meteorology, but shall confine myself principally to the other main division, which has been named—I believe, first by Prof. Balfour Stewart—Physical Meteorology. Under this term are included, amongst other important matters, fluctuations in the seasons; the causes, external to the earth, which occasion or contribute to them; and the laws which regulate these fluctuations. The opinion is daily gaining ground that this branch of Meteorology has been unduly neglected, that it offers a magnificent field of inquiry and discovery, and that its vigorous cultivation must greatly aid the solution of those more limited and local inquiries to which observation has been hitherto more particularly applied. My present object is to urge the cultivation of this wide and almost unoccupied field of research and to point out some of the steps which should now be taken to that end.

It will be necessary for my purpose first to advert to some of the most elementary facts connected with Meteorology. Speaking in general terms, there are but four principal elements concerned in the production of all meteorological phenomena—the familiar elements of antiquity—fire, water, earth, and air. The part played by each is obvious to every observer.

Water, sucked up by heat from the ocean, and from the land which has imbibed it, falls again from the clouds in the form of rain, undergoing alternately, through excess of heat, evaporation and condensation. *The earth*, a great recipient of both heat and moisture, gives up each gradually and silently, and helps to maintain equability of temperature and of humidity. *The air*, set in motion by heat locally applied, becomes breeze, or wind, or storm, according to the amount, duration, and locality of that heat. In each of these three cases we see that an external force, heat, plays a conspicuous part. Can either of the three named elements, Water, Earth, or Air, perform its functions without the aid of that external force? Have they any innate power, enabling them to act independently of each other, or of all external forces? Will water, if left to itself at an unchangeable temperature, rise into vapour and fall in rain? What power resides in the earth to cause meteorological phenomena? It may possibly be replied that it boasts volcanic power, but as this exists only locally, it can play but a small part in the great economy of the whole earth. The internal heat of the globe may also be claimed as an independent attribute of the earth, and it may be so—but on this question we have as yet but very little reliable knowledge, though much interesting speculation. It may, however, be stated that, as an explanation of leading meteorological phenomena, the internal heat of the globe has not as yet been allowed much, if any, weight, though its use as a modifier of such phenomena may be considerable. As to the air, no innate power has hitherto been assigned to it. We may therefore, without much risk of error, regard water, earth and air, for the purpose of the present inquiry, as three forms of inert matter, capable of exercising independently no force whatever, but when acted upon, either separately or in combination, by heat, capable of producing the most stupendous results.

We come now to this heat—the sun. Has this any innate power? It seems almost needless to answer the question. The most familiar occurrences attest his paramount influence: the alternations of day and night, the march of the seasons, the daily variations of warmth—all bear testimony to his all-pervading and tremendous power.

It might seem superfluous to state facts which are almost truisms. But would it not seem to follow as a matter of course, needless to dwell upon, that such being the paramount influence of the sun, its study must be the first and most anxious object of solicitude to the meteorologist? Yet such is not the case. Obvious as are the facts I have briefly indicated, they have led to no such result. The reports and volumes of observations emanating from bodies and institutions charged with meteorological researches often do not contain even the name of the sun, and it may be broadly stated that the great central source of heat, and therefore of all meteorological activity, receives little or no attention in that capacity. I do not prefer this as an indictment against those to whom I refer. Many reasons may be assigned for their total neglect of the sun. Perhaps amongst the most valid is the fact that instrumental appliances fitted for the purpose have not, until within a comparatively recent period, existed.

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[*] By Lieut.-Col. A. Strange, F.R.S., Inspector of Scientific Instruments to the Indian Government; a paper read at the British Association.

Another powerful reason no doubt is to be found in the difficulty with which even cultivated scientific minds can be brought to recognise, as a truth to be practically acted on, that no science stands alone, that all are intimately connected by nature, and that the classification and separation of various branches of inquiry is an artificial arrangement of man, adopted for the more convenient division of labour.

The time seems to have arrived when we ought to apply this truth to the science of meteorology, and to bring to its aid a class of researches calculated to provide it with that secure and rational basis of which at present it is absolutely destitute.

Before passing to a consideration of the steps which seem necessary to this end, I will touch slightly on one of the objects the hope to attain which fully justifies their being taken. I allude to the hope that we may thereby find some explanation and some law for the fluctuations of the seasons.

In a given locality, on a given date, the sun, to whom we ascribe so predominating an influence, attains, year after year, the same elevation above the horizon, and being at the same distance, presents the same angular area. If the sun, as that date annually recurs, were in all other respects the same, we should have a right to expect an annual recurrence of the same weather, unless some disturbing cause, of which we have at present no knowledge, were known to exist. I do not say positively that the sun being a constant force, we should have this constancy in the seasons—but what I do say is, that if the sun be not a constant force, we have no right to expect constancy in the seasons. The first question, therefore, should be: Is the sun a constant force? Does it, year after year, at the same date, present the same unvaried surface? We know that the contrary is the case.

We know that the surface of the sun's disc is never free from spots, and that these spots are constantly changing in number, size, and position: we know that whatever law may govern them, their period of change and return is certainly not annual.

We know also that the general surface of the sun is covered with markings called faculæ, which are perpetually changing, and which have not an annual period. We have also learnt, within two or three years, by the aid of the spectroscope, how at any time to examine the exterior gaseous envelope of the sun, which formerly could only be seen during a total eclipse, and we now know that the famous red prominences of which on those rare occasions we obtained only a fleeting glimpse, on being studied at our ease, without interruption, reveal evidence of activity in those regions of the most stupendous sublimity, darting out, in a few seconds, flames many thousands of miles in extent. Further, in examining the spectrum of the solar light with improved spectroscopes assisted by photography, we find that thousands of lines exist there of which hitherto we had no knowledge—and quite recently the researches of Norman Lockyer tend to throw a doubt on the fixity and constancy of some of these lines.

We have here evidence which conclusively proves that the sun's surface and surroundings are not maintained in a constant condition. The evidence may not justify us in asserting that as his surface changes so must the force which he pours out on the earth necessarily change also; but it certainly justifies us in entering on a systematic examination of that question with the appliances which modern physical astronomers have contrived for the purpose.

In what, then, should this systematic study of the sun consist? Up to the present time the spots have been the main object of study. Most valuable observations on these have been made, of which those of Carrington, of Howlett, of Selwyn, and of the Kew Observatory under the auspices and direction of Warren De la Rue and Balfour Stewart, may be mentioned as the most complete and most long-continued. But excellent as these series are, and great as is their value, this consists chiefly in their having shown the extent and character of the work that has to be done. They labour under the unavoidable defect of frequent interruption by cloudy weather—about two-thirds of the year are thus lost in England, and the evidence afforded by the remaining one-third is diminished in value. But even some of these researches have now been discontinued—in the case of Kew, for want of the requisite funds.

The conclusion arrived at by those who have devoted themselves to the subject is that *a daily record* of the changes taking place on the sun's surface is necessary. I will here advert only to the changes in the spots. These we already know do not take place arbitrarily: they gradually increase in aggregate area to a maximum, and as gradually decrease to a minimum—their period having been provisionally fixed at about 11½ years. But this period has been derived from observations of all the spots visible, without discrimination—and the "spotted area" is the aggregate area of all such spots. There is, however, reason to suspect that if it were possible to trace each individual spot throughout its existence, from its first formation to its final disappearance, there would be found to be different classes of spots having very different durations and perhaps very different maximum and minimum periods; and a reduction of these classes separately might, and probably would, result in a considerable modification of of the present 11½ years cycle, and possibly in the discovery of other cycles, at present masked in the period determined from all spots taken indiscriminately. But hitherto the absence of anything approaching a daily record of the spots has precluded any attempt to classify them. What is true of the spots is also probably true of all other manifestations of solar energy.

With respect to sun-spot researches, it fortunately happens that the photographic records need not be all taken at the same station. The record of one day taken in England can be combined with the record of the next day taken at the other side of the globe. Hence, in order to obtain this daily record it is only necessary to select a certain number of stations in localities such that there shall always be clear weather at one of them. India offers peculiar facilities for such a selection of stations, owing to the great variety of climate to be found in that country during the same period of the year. Perhaps four or five such stations would suffice for India, and if absolute continuity of record could not be obtained by them, the deficiencies could easily be made good by stations in our colonial possessions.

I think it hardly necessary that I should state that in advocating this system of continuous solar record I do not intend that other methods of meteorological research, now in use, should be abandoned. It is obvious that both methods must be employed. Whether present methods do not admit of considerable extension and improvement, is a very important question, on which, however, I do not here propose to enter. Nor do I intend to discuss the question whether the sun stations now advocated should not also be meteorological stations in the ordinary sense. This, like many other such questions which will have to be settled, is an administrative detail, which I shall not step aside from the consideration of fundamental principles to discuss.

It is scarcely necessary to point out that such a system of daily solar record as I have indicated is beyond the reach of individuals, and must, if attempted at all, be established and maintained by the State. The degree and direction in which the State should aid the advancement of science has been much debated of late, and the British Association has contributed powerfully, by obtaining a Royal Commission presided over by the Duke of Devonshire, to the solution of this difficult problem. As I have taken a part in these discussions, and have given considerable attention to the subject, I may perhaps, without impropriety, here state what appear to be the principles applicable to the particular case we are now concerned with.

The first principle is that private enterprise should not only be allowed the most perfect freedom from interference or competition by the State, but that it should be encouraged and aided in every possible way.

The second principle is that the State should step in where private enterprise fails, and itself conduct scientific research, whether observational or experimental, subject to the following main conditions:—

(*a*) That the probable results of the research will be beneficial, in the widest sense of that term, to the community at large, or to the various departments of the State.

(*b*) That the research is too costly, or commercially too unremunerative, to be undertaken and vigorously prosecuted by individuals.

(*c*) That the research requires continuous uninterrupted work extending over very long periods, and conducted by systematically organised establishments.

Probably no case could be mentioned as so completely satisfying these three conditions as that of researches affecting closely every interest in the community, needing for their conduct a number of well-equipped establishments, maintained, not merely for many years, but certainly for generations—possibly for centuries. This is work which it is futile to demand from individuals.

I wish to guard against being thought to assert that the study of the sun will certainly solve all the enigmas of meteorology. I do assert that the strongest possible *primâ facie* has been made out against the sun as the principal ringleader in meteorological agitation—and that there are ample grounds for putting him on his trial. Let us however suppose the impossible case of his absolute acquittal, I maintain that this negative result would be worth all the labour of obtaining it—eliminating, as it would do, one, and that the most conspicuous of probable causes, and so narrowing our inquiries to those that remain. The more likely event, however, will be that whilst the sun will be proved to be the chief promoter of these disturbances, his accomplices, and their various degrees of participation, will be dragged more prominently before the light.

Nor do I desire that the "innate power" I have attributed to the sun, and denied to other elements, should be misunderstood. I have used the term as the only one available to mark strongly the relative influences at work. I by no means intend to use the word "*innate*" in an absolute sense, or even to imply that the forces of the sun are self-generated and self-maintained. The object of this paper is a strictly practical one, and is not to be taken as intended to contribute one word to speculations on the constitution of the sun. But though disclaiming speculation, I may, on behalf of my practical object, point out that we already possess what *may* at least be claimed to be presumptive evidence that the sun is not exempt from external influences. I allude to the remarkable apparent connection which the researches of De la Rue, Stewart, and Loewy have established between the behaviour of the sun-spots and the positions of some of the planets, particularly Venus, the Earth, and Jupiter. I say that the mention of a result so well calculated to excite speculation, aids my practical object. I mean that by following up the hint given us by these most remarkable researches, we may be led to a more complete knowledge and more philosophical conception of the structure of the universe.

And I would here remark that I have urged the study of the sun from the meteorological point of view in order to give a practical justification for the adoption of definite practical steps. But that study is recommended by even higher considerations still, by the insight it must give us into cosmical relations, and the help it will afford us in seeking to understand something, if not of first causes, at least of causes of the highest order that our limited intelligence can grasp and reason on.

The more one reflects on the neglect of the sun justly chargeable against us, the more one wonders at it. It is like the case of a man placed before a steam-engine for the first time, and seeking to learn its principle and action by counting and measuring the bolts, screws, and rods, without giving a moment's attention to the source of power—the furnace and boiler. What they are to the steam-engine the sun is to us, and it is astounding that men should dare to undertake a solution of the complex and mysterious fabric which surrounds us without giving a foremost place in their investigations to the source of all material life and power.

Civilisation has been variously described and defined. It seems to me to imply above all things *completeness*. It aims at supplying all wants, at removing all obstacles to thought and to action, at making good all deficiencies, at remedying all evils moral and material, at guarding against all dangers, at promoting all beneficence, at extending and perfecting all knowledge. Science, as the most potent guide and instrument of civilisation, needs also to be complete. A harp with broken strings can discourse no music,—a chain with unconnected links can sustain no weight. Science, as our President so eloquently impressed upon us in the address with which he opened this Section, is one and indivisible. It has been broken up by man into its various recognised branches to serve his convenience and to assist the weakness of his intelligence; but nothing, as the same authority told us, is more subversive of truth and more hindering to progress than to regard these subdivisions as representing the actual order of nature. There must be doors of communication between the observatory, the laboratory, and the mathematician's study. The isolation of particular fields of research is no longer tolerable: each passes, however indirectly and insensibly, into the other through that "border land" which, as our President reminded us, "recent investigation has shown to be so fertile of discovery."

The study of the sun stands on this "border land." It belongs but very partially to the domain of the ancient astronomy, it possesses some holding in the provinces of chemistry and geology, and more still in that of physics, it claims as its right (as what branch of science does not?) the devotion of the mathematician, and it rules almost supreme in meteorology.

This study asks to be recognised and provided for. How much longer will the demand be disregarded?

*IN WHAT WAY AND AT WHAT STAGE CAN TECHNICAL INSTRUCTION BE BEST INTRODUCED INTO OUR SYSTEM OF NATIONAL EDUCATION**

IT will simplify the consideration of the subject, the discussion of which I have been requested to introduce, if we admit frankly that in England at any rate (I am glad to believe that Scotland is more fortunate) we do not possess a system of national education. Such a system, as I conceive it, should afford to all the children of the nation adequate elementary instruction, and, moreover, should offer to all, so far as their capacities and other circumstances will enable them to take advantage of it, full opportunity for further mental cultivation. There are lying before me the calendars of two German schools for boys of the middle class intended for a mercantile or industrial career: the Friedrich-Werder Gewerbe, or Trade School of Berlin, and the Real Schule, under the direction of Dr. Schellen at Cologne. The courses of each of these institutions following after some preparatory teaching in an elementary school or at home, where reading and writing together with a little arithmetic have been acquired, retain their pupils during nine or ten years; and boys who, according to the reports, were to become mechanical engineers, builders, postmasters, merchants, and chemists, left those schools last July, having attained the ages of seventeen to twenty years. The Real Schule of Cologne, the average number of whose pupils is 580, has 28 masters; the Gewerbe Schule of Berlin, averaging 540, has a staff of 32 masters. In every German town of the least importance there are, in addition to the Gymnasium or Classical School, one or more technical schools resembling those of Berlin and Cologne; the numerous Universities and Polytechnic Institutions furnish the requisite staff of teachers. The fees are small. I have no information as to those of the schools which I have quoted, but I find from the prospectus of another very celebrated trade school, that of Barmen in Westphalia, that its school fees for the year are from 3*l*. in the lowest to 6*l*. in the highest class, and that boys whose friends do not reside in the town are boarded for 25*l*. The governments, the municipalities, and private persons vie with each other in placing at the disposal of poor scholars of the elementary schools who have shown superior capacity, the means of continuing their studies in these secondary schools.

I need not describe the elementary schools of Germany and Switzerland; it is now well known that, in them, the children of the poor receive, up to the age of fourteen years, sound elementary instruction, not confined to reading, writing, and arithmetic, but including geography, the outlines of the history of their own and other European countries, a modern language, some elementary teaching in science, and instruction in the religion which their parents acknowledge.

As contrasted with a system of education such as I have referred to and excluding the great public schools, available only to the rich, we have in England for the middle classes schools like those attached to King's and University Colleges, the City of London School, the Bristol Trades School, and, thanks to the Endowed Schools Commissioners, a few efficient or at any rate progressive grammar and endowed schools, amongst which I would more particularly name the school at Giggleswick, near Skipton, as one where instruction in science has been included in the general plan of instruction; and a small number of exceptional private schools in which a praiseworthy attempt is made to adapt the instruction to the requirements of industrial and commercial classes. These schools however rarely retain their pupils beyond the age of fifteen to seventeen years, and when all are reckoned they are utterly inadequate to the wants of the population.

Of elementary school buildings we shall soon have a sufficient number, and it is probable that the duty of the parent to send his child to school will, in some way or other, be in all cases made a legal obligation; but so long as the necessity of rendering our training schools for elementary teachers thoroughly national and efficient is not acknowledged, and so long as the instruction of the children in elementary schools is left in a great measure to the care of other ill-taught children, called pupil-teachers, of from thirteen to seventeen years of age, we cannot hope that our poor will receive proper elementary instruction.

Until the English approach the German schools in number and value it would be vain to expect that technical instruction will be universally accessible, and we can only hope for its gradual introduction, availing ourselves of existing resources, with such improvements as may be looked for under the stimulus of the increasing interest evinced by some of our great corporations, by the parents themselves, and consequently by the Legislature.

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* A paper read before the Social Science Association, Oct. 1, by Mr. B. Samuelson, M.P.

One important step in the right direction has lately been taken :—Although the political chief is still a species of odd man whose duties include the passing of Ballot Acts, the suppression of foot-and-mouth disease, and the negotiation of Washington Treaties, the Government departments of literary instruction and of Science and Art have been placed under the control of a single permanent administrative head.

I understand technical instruction to include, besides the teaching of industrial manipulation, which for our present purpose we may exclude, firstly, drawing, mathematics, and the physical sciences, which are the bases of the industrial arts ; and secondly, the application of those sciences and of the art of design to industrial purposes. I should place in the first division such subjects as :—

Pure Mathematics.
Geometry.
Theoretical Mechanics.
Chemistry.
Physics.
Geology.
Physical Geography.
Biology.
Astronomy, &c. ;

and in the second—

Building Construction.
Naval Architecture.
Applied Mechanics.
Machine Construction.
Chemical and Manufacturing Technology.
Metallurgy.
Agriculture, &c.

Although this list is incomplete, it will be obvious that the field is too wide to be covered within the school period, even when the pupils remain at school to the age of adolescence ; bearing in mind always that instruction in technical subjects to the exclusion of other branches of a liberal education would defeat its own object. Much more is this the case with children leaving school between the ages of thirteen and sixteen. The choice of subjects must vary with the age at which school instruction is to terminate, and with the future career of the scholar.

A condition precedent, however, to the possibility of technical instruction is a due provision of science teachers. For these we must look, in the main, as to elementary schools, to our training colleges, assisted by such institutions as the Science School of South Kensington, and as to secondary schools, to the Universities, and to institutions like King's College, University College, and Owens College. The training colleges should add a third year to their curriculum ; instruction in mathematics and in some of the other subjects which I have included in the first division should be part of the obligatory course ; and no elementary school containing, for example, 100 children and upwards should, after a certain date, receive the Parliamentary grant on results, unless it had a teacher who had passed satisfactorily in Geometry, in Physical Geography, and in Physics or in Biology. A man thus qualified, having become familiar with the method of science, could, if he chose, afterwards acquire other theoretical subjects as well as those of application, included in the second division ; for instance, machine construction, chemical technology, or agriculture—availing himself for that purpose, as to the first class of subjects, of the annual courses for elementary teachers at South Kensington, or of any other means of instruction which may be within his reach. But if he stopped short at the limited but exact instruction in theoretical science which I suppose him to have obtained in the training college, he would be infinitely better qualified as a teacher than if during that course he had taken up a greater range of subjects superficially. Whether he be competent to teach many subjects or not, the children of the elementary schools whom he is to instruct have not time to acquire more than the rudiments of one or two theoretical sciences. At the same time an elementary teacher, who is qualified to give instruction in the applied sciences, will find employment in adult classes, such as those in connection with the Science and Art Department.

Assuming, then, that every elementary school for 100 pupils and upwards, which would include the principal village schools, had a master or assistant qualified in science, the course of such a school should include, for all the children, linear drawing and lessons on common objects which would be illustrated by locally accessible specimens ; the ordinary reading-book should also describe in familiar language the phenomena of nature. Those who are acquainted with the admirable text-books on Elementary Science of Prof. Balfour Stewart, Dr. Roscoe, and others, cannot doubt that the task of compiling such a reading-book will be undertaken by competent hands, as soon as the want of it becomes felt. Indeed, I am not sure that it does not already exist amongst the publications of the Irish National Board. The older children, those between the ages of ten and thirteen, should receive instruction in Physical Geography, in the elements of Trigonometry, and, from the age of eleven or twelve, in the rudiments of Biology or of Physics, perhaps, in some exceptional cases, of both. More cannot be done for them in the elementary school ; a few should be drafted into the secondary school ; but the greater number would at the age of thirteen become full time-workers in the field, at the bench, or in the factory ; possessing, however, as is now but rarely the case, the elementary instruction required for taking advantage in their leisure hours of the science classes which are to be found in almost every district of the United Kingdom. How much may be done there is evident from the success of the Andersonian University in your city, with its 1,400 students, to whose founder belongs the honour of having been, more than a century ago, the originator of scientific instruction to the working classes. Children thus taught from the commencement by such masters, when they afterwards receive instruction in science, would not be subjected to, and would revolt against, cram like that recorded in the Report of the Science and Art Department for the present year, in which Prof. Ramsay, the examiner in Geology, says that "candidates answer one of last year's questions in place of one of this year's, as if they had been specially crammed in last year's examination ;" and Prof. Carey Foster, acting with Dr. Tyndall as examiner in Acoustics, Light, and Heat, states that a good number of candidates in the advanced stage "suppose that in order to *damp* the vibrations of a string it is needful to *wet* the string," and "that a ship is the kind of vessel that would usually be employed for containing air."

Amongst other conspicuous examples of adult instruction in science given to the class whose education has been received in elementary schools I may name the lectures for working men of Owens College, numbering more than 600 students, under the gratuitous tuition of the professors of that institution, and those of the Miners' Association of Cornwall and Devon, organised some dozen years ago by Mr. Robert Hunt, F.R.S., Keeper of Mining Records, whose teachers seek out the working miner in his village and make him familiar with the laws of the forces and the properties of the matter with which he is brought into contact in his daily work. But time is wanting to allude further to the subject of adult elementary instruction in science, nor will I enter into the question of science teaching in our great public schools, which has been inquired into by Mr. Norman Lockyer, F.R.S., the secretary of the Royal Commission on Scientific Instruction, whose report will doubtless be forthcoming before long.

In secondary schools, assuming the existence of competent teachers, and that they retain their scholars from the age of eight or nine to sixteen or seventeen—I should commence, as in the elementary school, with lessons in drawing and on familiar objects, and in Physical Geography ; and introduce Mathematics, beginning with Geometry at the age of eleven or twelve, continuing it until the pupil leaves school ; systematic instruction in the elements of natural science might begin at the age of ten to eleven with Natural History, including Geology ; and the six years until the pupil leaves at the age of sixteen or seventeen could be made readily to include successively the elements of that science and of Physics and Chemistry. With the exception perhaps of applied mechanics, it would not in my opinion be possible to include the applied sciences, but the teacher would illustrate his instruction by practical applications. Work in the laboratory is a necessity if a thorough appreciation in kind, however limited in extent, of natural science is to be acquired ; but the experience of the Rev. W. Tuckwell, of the College School at Taunton, communicated to the British Association, and of others, shows that a school laboratory need not cost more than 200*l*. to 400*l*.

Only in those cases where school education is continued to the age of eighteen or nineteen years would it be desirable to introduce such subjects as building, or machine construction, or chemical technology. In all other cases more real progress would be made by devoting all the available time to theoretical science. The scholar who enters into active life as an apprentice at the age of sixteen or seventeen, would see in the workshop the application of the principles which he would have learnt at school, and, if diligent, he would find opportunities of further study in adult classes, in factories, and in text-books on special subjects. For instruction in the entire range of theoretical and applied science it would be necessary that the student should continue the course, commenced during the school age, at the University or at a Polytechnic Institution such as there is now some hope that the Science School at South Kensington may become.

Although I have excluded instruction in technical manipulation from the subject of this paper, I think it right to add that the students of King's College and of King's College School save much time and drudgery during their pupilage by the practical skill acquired in the workshops attached to the College, and that according to competent observers like Mr. Nussey, of Leeds, the artisans of Elberfeldt, Crefeld, and other continental towns derive great advantage from the schools of design and so-called weaving schools.

I should not fulfil my duty if I were to conclude this paper without acknowledging, though no alarmist in regard to foreign competition, that other nations, less energetic, less rich in accumulated capital and practical experience, and without the advantage of our great mineral resources, are, thanks in a great measure to their superior technical training, making relatively greater advances than ourselves in many branches of industry, and that the conviction of the necessity for such training has not arisen amongst ourselves a day too soon. Happily it has arisen, and in the most desirable quarters. Manchester, by the judicious enlargement of Owens College, to which its merchants and manufacturers have quite recently contributed a sum approaching 200,000*l.*; Yorkshire, by the establishment of the College of Science at Leeds, to which secondary schools of science are to be affiliated; the Company of Clothworkers, by the foundation of scholarships, and the endowment of a chair of textile technology in the Yorkshire College; the University of Durham, and the coal-owners and manufacturers of the North of England, by their joint foundation of the School of Science at Newcastle; Oxford, by its patronage of the College to be established at Bristol; and the Company of Merchant Adventurers, by the aid which it is giving to the Trade School of the same city—are not only directly promoting the higher technical instruction amongst the populations in which their work is done, but will furnish competent teachers to the elementary and secondary schools of their own and other localities. I think there is no fear that a work of such national importance once so actively begun will suffer any relapse; but it will be in the power of this Association to promote by discussion and advice its intelligent and economical organisation.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, Oct. 5.—M. Bertrand in the chair.—The following papers were read:—Researches on the conditions of resistance in cylindrical boilers, by M. H. Resal.—On the exact values of the angles in the crystals of titaniferous iron, by M. N. de Kokscharow.—Report on the machine for freezing by the evaporation of methylic ether, invented by M. Ch. Tellier; and on the preservation of meat in the air, cooled by this apparatus, by the Commissioners, MM. Milne-Edwards, Peligot, and Bouley.—On the temperature of the sun, by M. J. Violle. The author starts with the fundamental equation $a^{\theta} - a^{t} = \frac{\omega}{s} a^{x}$, and from determinations of the intensity of solar radiation assigns the value 1550° to what he calls the *effective temperature* of the sun. The true mean temperature of the surface of the sun is estimated at 2,000°.—Note on magnetism, by M. J. M. Gangain, a continuation of former researches.—Seventh note on the conductivity of ligneous bodies, and of other substances which are bad conductors, by M. Th. du Moncel.—Experimental researches on explosive substances, by MM. Roux and Sarran.—On a register giving continuous indications for the determination of the law of variation of pressures produced by the gases of gunpowder, by M. Ricq.—On the synthesis of purpurine, and of some analogous colouring matters, by M. A. Rosenstiehl.—New observations on the chemical composition of the waters of Bagnères-de-Luchon, by M. E. Filhol.—Method of determination of copper by means of titrated liquids, by M. Pr. Lagrange.—Comparative and critical examination of the hypotheses which have been advanced to explain the figure of comets and the acceleration of their motion, by M. H. Champion. The author attempts to show in this memoir: (1) that a force directed along the radius vector develops in the two opposite parts of an elliptical orbit separated by the major axis, two tangential components of contrary signs, of which the effects are exactly compensating; (2), that the force gives rise to a third component opposed to gravitation, of which the final result is to increase the dimensions of the orbit; (3), it is shown that at the distance at which comets' tails commence to be seen, the rays of the sun would not produce an appreciable elevation of temperature in a highly rarefied substance.—On the comparative chemical composition of the different parts of the vine when healthy and when attacked by *Phylloxera*, by M. Boutin.—Experiments made at Cognac on phylloxerised vines with the coal-tar recommended by M. Petit, by M. P. Mouillefert.—Experiments made at Montpelier with the same substance, by M. Alph. Rommier.—Observations on the points gained by science concerning the known species of the genus *Phylloxera*; a letter from M. Signoret to the perpetual secretary.—Observations concerning the recent communication of M. Balbiani on the different known species of the genus *Phylloxera*, by M. Lichtenstein.—Trial of infection of a healthy vine by putting *Phylloxera* in contact with its roots, by M. Delorme.—On the means proposed to check the propagation of *Phylloxera*, the method of uprooting in particular, by M. P. Naudin.—Experiments on a method of treatment of phylloxerised vines, by the sap of a Euphorbia, by M. L. Balme.—On the appearance of *Phylloxera* in the canton of Geneva, and on different curative measures proposed, by M. E. Ador.—The Minister of Foreign Affairs transmitted further details of the recent eruption of Etna.—M. Dumas announced that the news received from the first four Transit of Venus expeditions was satisfactory on all points.—On the pretended Saharan Sea, by M. A. Pomel.—Observations on the ancient central sea of the Tuniso-Algerian Sahara, by M. Virlet d'Aoust.—On the theory of curves in space of n dimensions, by M. C. Jordan.—Electro-diapason of variable period, by M. E. Mercadier.—Electro-spectral tube, or "fulgurator," for the observation of the spectra of metallic solutions, by MM. B. Delachanal and A. Mermet.—Note on supersaturation, by M. Lecoq de Boisbaudran.—On the action of bromine on certain alcohols, by M. E. Hardy.—Note on the production of oxamic acid by the oxidation of glycocol, by M. R. Engel.—Action of heat on diphenylmethane and phenyl-toluene; on the products of the reduction of benzophenone, by M. Ph. Barbier.—Curious association of garnet, idiocrase and datholite, by M. J. Lawrence Smith.—Balloon meteorological observations, by M. G. Tissandier.—Note on the spectroscopic observations made during the balloon ascent of Sept. 24, for studying variations in the extension of the colours of the spectrum, by M. W. de Fonvielle.—On the feeble influence which diluvian waters have exercised on the formation of the valleys of the Paris basin, by M. E. Robert.

BOOKS RECEIVED

British.—Synopsis of an Arrangement of Invertebrate Animals in the Free Museum of Liverpool, with Introduction by Rev. H. R. Higgins (Marples).—Babington's Manual of British Botany. 7th edit. (Van Voorst).—Mineralogy: Frank Rutley, F.G.S. (T. Murby).—The Sanitary Condition of Oxfordshire: G. W. Child (Longmans).—Symond's Rainfall for 1873.—Sixteenth Report of the East Kent Natural History Society (Canterbury).—Amateur's Photographic Guide Book: Stillman (Smith, C.D.).—The Principles of Modern Pantheistic and Atheistic Philosophy: C. A. Row (Hardwicke)—Micrographic Dictionary. Parts xiii. and xiv.: Griffith and Henfrey (Van Voorst).

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DIARY OF SOCIETIES.

LONDON

FRIDAY, OCTOBER 16.

MEDICAL MICROSCOPICAL SOCIETY, at 8.—Opening Meeting of the Session.

FRIDAY, OCTOBER 23.

QUEKETT MICROSCOPICAL CLUB, at 8.—On cutting Sections of the Eyes of Insects, and on a New Instrument for that purpose: R. P. Williams.

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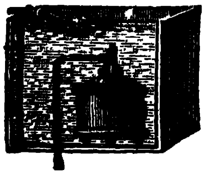

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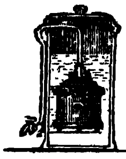

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THURSDAY, OCTOBER 22, 1874

*THE UNIVERSITIES COMMISSION REPORT**

II.

IT has of course been always well known that the endowments of Oxford and Cambridge have been by law restricted, till within the last few years, to members of the Established Church; but to the outside world it will probably be a surprise to learn from this Report how far-reaching have been the consequences of this restriction, and how deep is the ecclesiastical character which has been thus imprinted upon a large portion of the academical wealth which the nation imagines to be at its own free disposal. It must be premised that in this respect, as in so many others, Oxford furnishes far more matter for comment than Cambridge, so that the following illustrations will be mainly taken from the former University; and also that it is regularly in the most wealthy Colleges that ecclesiastical objects receive a disproportionate amount of pecuniary aid: two circumstances which point to the conclusion that it is superfluity of income which causes the interests of education and learning to be cast into comparative neglect.

The synoptical tables at the end of this volume state that the Oxford Colleges have in their gift or annexed to their Headships 436 benefices of the returned annual value of 187,000*l.* It is notorious that these returns are considerably below the gross amount actually received, but as they stand they represent a sum equal to more than two-thirds of the total amount which these same Colleges receive from their corporate endowments. The proportion at Cambridge is not quite so large. Some of the Colleges have exercised their statutory powers of selling their advowsons, but to no great extent, and it is yet a moot legal point whether the money produced from such sales can be diverted to purely secular objects. It is noticed, however, by the Commissioners, that in one or two cases such money has been carried to the ordinary account, and that in others it has been appropriated to purposes which otherwise must have been paid for out of the corporate revenue. The proper disposition of the wealth represented by these advowsons is clearly one of those questions which should not be left to the varying and self-interested action of the individual Colleges, but must be resolutely faced by Parliament, and if it be decided in the way which the progress of modern opinion seems most disposed to favour, there will result a very large increase on the total of 260,000*l.* a year mentioned last week as the clear sum available in the reconsideration of the endowments of Oxford. According to another heading in the synoptical tables the total sum of 8,600*l.* is expended upon the College chapels at Oxford, a total which will probably not be considered too large, when it is also stated that out of it are maintained the great choral services at Magdalen, New, and Christ Church, at an average of more than 2,000*l.* each. This sum, however, deserves quotation, if only out of contrast with the item which follows under the head of "Library," which amounts at Oxford to the bare pittance of 1,300*l.* Here also the amounts expended at Cambridge upon the ecclesiastical and secular establishments stand in a similar proportion. It is true that the libraries are awarded something besides from Trust funds and from fees on graduation, but the circumstance that their wants are so conspicuously put into the second place is most significant of the general tone of feeling prevalent at the Universities on these matters.

Another item in these tables is headed "Subscriptions and Pensions," amounting at Oxford to close upon 9,000*l.*, which may not perhaps seem an extravagant expenditure for the owners in fee of so much landed property; yet it will be viewed with much suspicion by those who know how feeble College meetings are in their resistance to the importunities of past members of their body seeking pecuniary help for all those objects which the Church of England takes upon itself to perform in rural parishes. The part of this subject, however, which is destined to attract the largest amount of public attention is that which has reference to the augmentation of College benefices out of corporate income, a process by which, as was before tolerably well known, the clerical fellows, forming as they do a majority in the governing bodies, provide comfortable pensions for their own declining years, and at the same time evince their interest in the general welfare of the Church. The extent, however, to which this process has been carried on is now revealed for the first time, though it is not quite apparent whether all has yet been disclosed, for in the course of their inquiries on this topic the Commissioners have not unnaturally been met with considerable reluctance, and in some cases apparently even with evasion. The synoptical tables for the Oxford Colleges give the amount thus annually devoted as just 9,000*l.*, which may be thought a fully sufficient charge for this item, being more than is set apart for College officers, for the management of estates, or for investment. This figure, however, it cannot be too widely known, is a totally delusive one, and probably does not represent one quarter of the amount which is really squandered in this way. This conclusion would be at once suspected by anyone who has an inkling of the facts, when he reads that Queen's is credited in this table with nothing at all, and Magdalen with only 17*l.* 10*s.* A more particular examination of the full returns made by the individual Colleges amply confirms these suspicions by proving, though in a roundabout way, that Queen's really pays away to incumbents 3,000*l.* a year, and Magdalen no less than 9,000*l.* To this it may be added that Christ Church, which in the tables is only credited with 2,000*l.*, does as a matter of fact spend just four times that amount; and that since 1835, and chiefly within the last few years, has given away 28,000*l.* for cognate ecclesiastical purposes. In connection with this subject, it may be mentioned that Magdalen possesses a certain benefaction called the Sheppard Fund, subject to no specific conditions, except that the proceeds are to be appropriated "to such uses as are likely to promote piety and learning in Magdalen or any other College." Out of a net 2,000*l.* a year received from this fund, 300*l.* is spent on management, &c., the ambiguous item of subscriptions runs away with 470*l.*, while 720*l.* is swallowed up in ecclesiastical objects, leaving a bare 540*l.* for Magdalen College and other schools. The accounts of the Hulme Trust connected with Brasenose teach the same lesson, for in that case no less than 4,000*l.* per annum out of a net revenue of 6,000*l.*, under the authority, it is true, of recent Acts of Parliament, is devoted to livings and churches; a considerable deviation, as the Commissioners observe, from the intention expressed in the will of the benefactor. The returns of the value of the Professorships are equally significant, for the five Divinity Chairs are each endowed with 1,500*l.* and a house, whereas the average of the remaining Professorships cannot be more than 500*l.* without a residence. It may here be incidentally mentioned that the collective income of the Oxford Professors from all sources amounts to 25,000*l.*, of which only 450*l.* comes from fees, and more than half of this latter sum from the fees of the four Science Professors.

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* Continued from p 476.

Concerning the number of Fellowships confined to those who have taken or who have promised to take orders, this Report is entirely silent, on the same principle apparently as it omits to state what proportion of the College endowments is appropriated to the encouragement of Physical Science. For information on this latter topic, recourse may be had to the Report [illegible] another Royal Commission lately published, and the University Calendars yield some evidence on the former point. As to Oxford, it has been calculated that with the exception of Merton, where for the future all Fellowships, as well as the Headship, will be entirely open, nearly half the Fellowships are what is commonly called clerical, and all the remaining Headships are confined to clergymen. The proportion in the different Colleges is very irregular, but the reader will hardly be surprised to learn that, in accordance with what has been intimated above, at the four wealthiest Colleges the proportion is as high as two clerical fellows to one lay.

All these facts, and there are more of the same character, seem to point one way: that when the reconstruction of the Universities becomes a matter of public and not special interest, and when the uses to which their endowments are put shall be fundamentally reconsidered in the light of modern experience, one of the first questions which the nation will have to decide for itself will be whether so large a portion of academical property shall in the future be limited to purposes which certainly are not educational, and nowhere else than in England would ever be thought to be academical. That the Colleges themselves cannot be permitted to settle these great questions at their own sweet will is abundantly made clear by the facts recorded in this Report. It may be granted that the reformed statutes of a few of the Oxford Colleges, which are appended at the end of this volume, promise to abolish certain of the more prominent evils in their constitution, which evils indeed nowhere find any active defenders; but in none of these schemes is adequate importance attached to the duty of encouraging original research, the one part of its academical functions which Oxford neither performs nor regrets to have left unperformed. Moreover, the well-intentioned activity of some three or four of the less wealthy Colleges affords no guarantee that the greater institutions will not continue in their wasteful courses, and permit fresh vested interests to be acquired daily. Perhaps public opinion is not yet fully ripe, and perhaps those who have interested themselves in these subjects are not yet sufficiently unanimous; but for the future, at any rate, no excuses of this kind ought to be tolerated. The Commission on Scientific Instruction and the Advancement of Science has thrown into shape a scheme of reform which, though primarily adapted to the case of original research in the physical sciences, is capable of being extended to similar branches of genuine study, and to the outline of that scheme many prominent men, statesmen and others, have given in their adhesion. This Commission has now in its Report given us all the materials requisite for discovering where the necessary funds shall come from; and from henceforth it will be only due to laziness, or to individual perversity, if a definite scheme of University Re-organisation, conceived in the interests of unencumbered investigation and mature study, is not soon presented for the acceptance of the public.

SEDLEY TAYLOR'S "SOUND"

Sound and Music: a Non-mathematical Treatise. By Sedley Taylor, M.A. (London: Macmillan and Co.)

FINDING from the title-page and preface that this work, though non-mathematical, undertakes to give an account of the acoustical discoveries of Helmholtz, we acknowledge having felt some misgivings when we commenced the perusal of it. We will presently inform our readers whether we found our fears justified or not by the book itself; but we must first state why we felt them.

The recent reasonable and even necessary outcry for popular scientific education in this country has led to the publication of a perfect shoal of elementary treatises. Everyone who has a smattering of knowledge or who has access to a consulting library considers himself thereby fitted to write a treatise. For one such that is written by a man thoroughly competent as far as knowledge and experience can qualify him, we have half a dozen written by popular lecturers, or rather showmen, in whose eyes sensational experiments sensationally described form the really attractive portion of science! Besides these, we have a dozen others—some the work of those fluent writers who can master a new subject in a week, complete an octavo treatise on it by the end of the month, see it through the press, and proceed immediately to repeat the process on something newer still; the others, the original work of uninstructed but aspiring men, who have learnt too little to be aware either of what science is or of their own utter ignorance of it. This is no fancy sketch, but, as all competent to judge will allow, an exceedingly unpleasant reality. In some subjects, no doubt, competent men have the field (as yet) left almost to themselves. It is only now and then that an ignoramus ventures to produce a treatise on Hyperdeterminants, Vortex Motion, or Specific Inductive Capacity. Yet, if books on such subjects could command a host of eager *and ignorant* purchasers, there would soon be a supply from quarters hitherto undreamt of. But anyone and everyone can write on such simple matters as heat, light, electricity, or (more to our present purpose) sound and music. "Bother Helmholtz, and Clerk-Maxwell, and Thomson," cries a public athirst for sensation, and whose palate is already dead to all but the most potent spices; "we want excitement, knowledge too if it comes painlessly, but excitement;" which (viz. the sensation and the excitement) are precisely what that same public will *not* get from Mr. Taylor's work. Not once, in the whole course of his 219 pages, has he condescended to cater for the mere amusement of his reader. We hope, but almost against hope, that this will not interfere with the sale of his book.

The book, with the exception of a few slight blemishes, to some of which we will presently advert, is a very good one indeed: lucid, comprehensive, and accurate. Many of the more difficult ideas introduced are illustrated very happily by analogy; and, so far as the first half of the volume is concerned, there is nothing which should present a difficulty to any reader of average intelligence. It is necessarily otherwise with the second half, which treats mainly of music, for this is a subject which mere intelligence, however acute, will not enable a man to master. One may as well discourse of colours to the congenitally blind, as of music to a man devoid of "ear." It has often struck us as one of the most remarkable of phenomena in the physical world, that while we ourselves were only greatly annoyed by the discordant grinding of some street-organ miscreant, one friend beside us has been almost in a state of frenzy, while another, on the contrary, listened with the most stolid indifference. [We leave it to the psychologists to consider whether the mind itself may not, in certain individuals, have similar excess or defect in some particular quality, and if so, to explain by it the existence alike of sceptics and of fanatics.] Considering that this extraordinary difference is often found to exist between individuals nearly related, and in all other particulars closely resembling one another, it is not to be wondered at that even among those who possess in a special manner an ear for music, individuals should be found to differ widely from one another on many of the less important points. In such a case who is to decide? *Cæteris paribus*, we should be inclined to side with the mathematician, who has, as it were, an extra sense in addition to those possessed by his antagonist. Wherever, then, we find that Mr. Taylor's view is not exactly in accordance with that of Helmholtz (though the discrepancies, so far as we venture to think we understand them, are few, and, with one exception, of apparently small importance), we are inclined to take the side of Helmholtz. But, we repeat, this is not to be considered as a demerit of Mr. Taylor, for the main point of variance (if we be correct in supposing it to exist) seems to be an æsthetic one, upon which only a comparatively small number of persons (and these not only exceptionally gifted, but also highly trained) are competent to form an opinion. We outsiders may judge of the value of such opinions by comparing the verdicts of different art critics on the same picture; though in the case of sound, where the physical processes (in the external ear at least) are thoroughly known to the mathematician, he ought to have a decided advantage over those who have not his physical insight. The following passage (§ 75), seems particularly happy:—

> "That *two sounds should produce absolute silence* seems, at first sight, as absurd as that two loaves should be equivalent to no bread. This is, however, only because we are accustomed to think of sound as something with an external objective existence; not as consisting merely in a state of motion of certain air-particles, and therefore liable, on the application of an opposite system of equal forces, to be absolutely annihilated."

There is, however, considerable objection to be taken to the word *forces*. Had Mr. Taylor said *motions*, or still better *disturbances*, the passage would have been not only clearer but more correct.

A closely-connected mistake occurs, in two different forms, in §§ 22, 50. In the former, the word *force* is used in place of *energy*; in the latter, *energy* is used where *force* is obviously the correct word. But here, though in all probability unconsciously, Mr. Taylor is only following the metaphysicians and other quasi-scientific men, who give what they call a "broad basis" to the meaning of a word by using it now in one sense and anon in quite a different one.

Another curious statement, occurring in § 8 and repeated in § 37, seems to show that Mr. Taylor's clock has a half-second pendulum, for he speaks of a *complete* oscillation (from side to side and back again) as taking place in one second!

The inherent defect of all non-mathematical treatment of a subject undoubtedly mathematical shows itself in the elaborateness of Mr. Taylor's explanation of wave-motion. We are quite sure that a very slight amount of the most elementary geometry, properly introduced, would have enabled him to condense the whole of this part of his work into one-third of its present bulk or even less, and this with a decided increase of simplicity and intelligibility to the ordinary reader.

We object entirely to the word *strictly* in the foot-note to § 5, for, instead of being *not strictly accurate*, the statement referred to is not even approximately accurate. In the same section there is an illustration of wave propagation by the alternate kneeling and standing of the individuals of a line of men, where the reader is likely to be much puzzled by the printing of "two, six, and nine," instead of "twenty, sixty, and ninety." This, however, may be called hypercriticism, so we proceed to point out that in § 23 there is a genuine blunder. Mr. Taylor says that in the diminution of loudness and dying away of the sound of a pianoforte wire once struck, "the effect produced is the same as if our harmonium had, while sounding out its note, been carried gradually further and further away from us," forgetting altogether what, indeed, we do not find in his book, the lowering of pitch which accompanies diminution of intensity when the source of sound moves away from the observer.

In § 54 the word *submission* (subdivision?) produces a curious effect, due probably to the printer.

We conclude by repeating that the work is a very good one, worthy of the subject; and that we are glad to see that (in default of an English translation of the "Tonempfindungen") the beautiful discoveries of Helmholtz have found in this country an able and congenial expositor. Had we thought less of the work we should not have been driven to criticism of mere isolated words or phrases which easily escape detection by an author himself. Yet, after all, we must conclude with an expression of amazement that a man who shows himself to have so thorough an appreciation of harmony as does Mr. Taylor, should tolerate for a moment in his pages a foreign word such as *timbre*, when we have an excellent and generally received English equivalent for it; or employ for a concord such a hideously inappropriate word as the English *clang*.

MAREY'S "ANIMAL MECHANISM"

Animal Mechanism. By E. J. Marey. "The International Scientific Series." (London: Henry S. King and Co., 1874.)

I.

On more than one occasion during the last year or so, we have drawn attention to a small French physiological treatise by Prof. Marey, entitled "La Machine Animale." It is not only to a passage here and a passage there that we have had to refer, but to the thorough exposition of intricate problems of mechanical physiology, which have been worked out with a degree of ability rarely to be found in a single author. It is a translation of this work which forms the subject of the present review.

Prof. Marey divides his subject into three parts: the first devoted to general principles; the second to terrestrial locomotion; and the third to aërial locomotion. It is to the last two of these that we wish to draw attention both in this and the succeeding notice.

Terrestrial locomotion comprises that of bipeds and that of quadrupeds: man and the horse, exemplifying them respectively in their most complicated forms, serve as excellent examples. Human locomotion is a subject which admits of more scientific treatment than might at first sight be supposed. There is no better proof of this than the fact that until Prof. Marey quite recently disproved it, the theory of the brothers Weber was generally accepted, namely, that the non-supporting leg moves pendulum-like in walking.

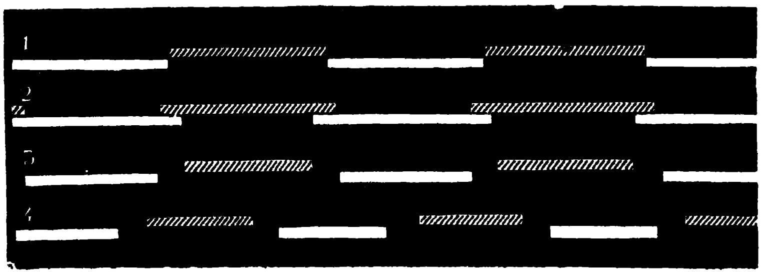

Fig 1.

Whilst, with the mind otherwise unoccupied, anyone sets to work to study the different movements of his legs in hopping, jumping, walking, and running, there are many points that he can make out without further assistance, such as the fact that in walking the feet are never both off the ground together, whilst in running the body is unsupported between each two steps. Our author and one of his pupils, M. G. Carlet, have, however, succeeded in putting down the results of their carefully conducted experiments in a form which allows of their being studied by others as well as by the subjects of the experiments themselves. By means of elastic air-bags with connecting tubes they have transferred the movements they discuss to paper, and have had these tracings copied as woodcuts.

After having proved that the intensity of the pressure of the foot upon the ground is not solely dependent on the weight of the body, it being greater at the end of the step than at its commencement on account of the muscular effort then added, Prof. Marey describes the vertical and horizontal movements of the body in walking, and shows that the former oscillations are twice as numerous as the latter. This can be verified by observation; at all events, the rise of the body can be seen to be as rapid as each step, whilst the slowness of "the waddle" is proverbial. Next, the greater pressure at the end of each step is proved, by a very ingenious contrivance, to increase the forward movement of the body during that time, and to be least at the moment when the foot reaches the ground.

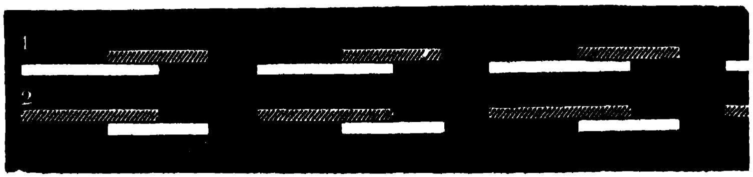

Fig. 2.

In describing the rhythm of the different modes of progression adopted by man, the tracings obtained by the recording instrument are transcribed into a notation which is a modification of that employed in music. Two horizontal lines form the staff on which this simple music, consisting of only two notes, is written. A broad white line expresses by its length the duration of the pressure of the right foot; a similar shaded line does the same for the left; any interval between the two indicates the time during which the body is suspended above the ground. On this method the diagram in Fig. 1 will represent the formula of the rhythm of the walking pace (1), of ascending a staircase (2), of running (3), and of rapid running (4). From these it may be gathered that in walking the contact of one foot with the ground follows that of its fellow without any interval; that in climbing a hill or going upstairs there is this difference, namely, that the one foot does not leave the ground until its fellow has been in contact with it a perceptible time; that in running there is an interval at each step during which the body is quite off the ground; and fourthly, that in rapid running, though the duration of each step is shortened, that of the interval is lengthened.

Fig. 2 represents the gallop of children, (1) being what may be termed left gallop, and (2) right gallop, according to which foot is in front. This rhythm will be found instructive when we come to refer to the same in the horse.

The upper of the two portions of Fig. 3 represents a series of leaps with the feet together, whilst the lower is the notation of the hop on the right leg, in which, from fatigue, the duration of the time of contact with the ground increases; it will be observed that the time of suspension, nevertheless, does not vary. All these diagrams are so instructive in themselves that they need no further detailed explanation.

Fig. 4 will give an idea of the instrument employed in studying the complicated problem of quadrupedal action, in which it will be seen that the movements of each foot communicate, through elastic tubes, movements to the levers of the recording apparatus held in the hand of the rider. In interpreting the tracings thus obtained into the musical notation above employed to describe the different rhythms of human progression, the only thing necessary is to introduce a second pair of bars below that previously employed, to represent the hind feet. A diagram like Fig. 1 is the result. Before the introduction of this graphic method, the action of the horse, which used to be an endless subject of dispute, was made out from the imprint of the shoe-marks left in soft ground; this, however, varies for any given action with the rapidity of movement and the size of the animal which forms the subject of experiment.

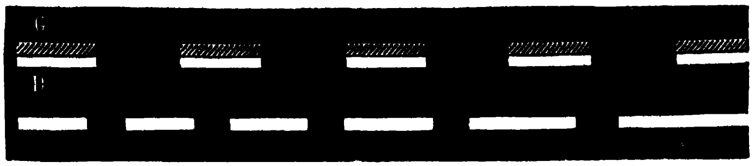

FIG. 3.

As we explained not long ago (NATURE, vol. x. p. 39), according to the work before us, the action of the horse in walking, we need not discuss that step on the present occasion. It is by far the most complicated of the movements. The trot is much more simple, being a double instead of a quadruple action; the opposite fore and hind feet striking the ground simultaneously. There is also an "irregular trot," which is frequently met with, and depends on a lag in the action of the hind limbs.

"Several different paces, the common character of which is that irregular impacts return at regular intervals, are comprehended under the gallop." There is the gallop in *two*, *three*, and *four* times, so called according to the number of sounds heard in each completed pace Fig. 5 gives the notation of the gallop in three-time, which is the most common; *A* indicating the time, and *B* indicating the number of feet which support the body at each instant of the step. From it the left hind-foot is seen to reach the ground before any of the others, and to produce the first sound: the second is caused by the simultaneous impact of the right hind and left fore feet; and the third by the right fore-foot, which the animal always places forward to commence with. The similarity between this pace and that of children "playing at horses" can be readily seen by comparing this figure with Fig. 2. The gallop in four-time differs from that just described, in that the impacts of the hind legs are slightly delayed, which causes the two feet, which in three-time strike the ground simultaneously, to do so one after the other, the right hind one after the left fore, so that the single sound is duplicated.

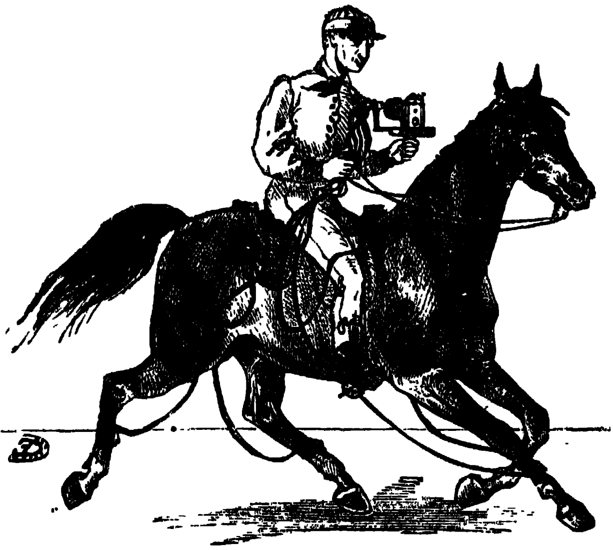

FIG 4.

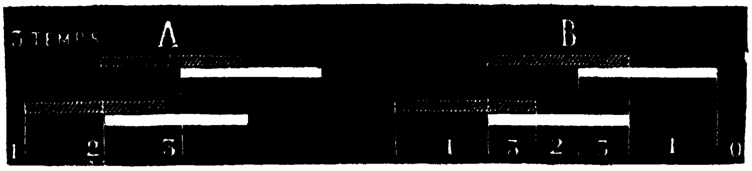

FIG 5.

The full gallop is so violent an action that the delicate instruments employed in analysing the previous movements have to be dispensed with, and a more substantial apparatus employed. The rider, instead of carrying it in his hand, has it tied, as a knapsack, on his back, and he sets the recording watchwork in motion with his teeth. Notwithstanding the difficulties of the experiment, very successful tracings have been obtained, which show that the full gallop is really a gallop in four-time, in which, although the fore-feet hit the ground with a fair interval, the hind feet hit it nearly simultaneously. The time of complete suspension is extremely short.

Besides the actual and relative durations of the different paces, Prof. Marey's instruments are so constructed as to record also the rise and fall of the body of the horse during each. This point is of particular interest, as it explains the varying degrees of comfort to the rider in the trot, gallop, &c. The rise in the trot is sudden and simultaneous with the time the animal's feet are on the ground, and the fall with the time of suspension. In the gallop the same is the case, though the rises and falls are less sudden; they are, "therefore, less jarring to the rider, though they may, in fact, present a greater amplitude."

(*To be continued.*)

OUR BOOK SHELF

1.—*Les Roches; Descriptions de leurs Éléments: Methode de Détermination, etc.* Par Edouard Jannetaz, Docteur ès Sciences, etc. (Paris: J. Rothschild, 1874.)

2.—*Les Minéraux: Guide Pratique pour leur Détermination, etc.* Par F. de Kobell. Avant-propos et Additions, par F. Pisani, Professeur de Chimie et de Minéralogie. (Same publisher.)

3.—*Le Monde Microscopique des Eaux.* Par Jules Girard. (Same publisher.)

THESE three works form part of a series of popular scientific treatises issued by the enterprising Paris publisher, M. Rothschild. They are small volumes neatly printed and got up, and Nos. 1 and 3 are fully illustrated with well-executed cuts.

No. 1 is intended as a practical guide for the use of engineers, geologists, mineralogists, agriculturists, and pupils of Government schools. It is illustrated with thirty-nine woodcuts, contains a great deal of valuable information in small space, and seems well calculated to form a useful little handbook for the classes mentioned.

No. 2, which is a translation from the tenth German edition of Kobell's work by Count L. de la Tour-du-Pin, with a preface and additions by Prof. Pisani, is intended for the use of chemists, engineers, manufacturers, &c., and, like the above, seems well calculated to serve its purpose, of helping those who have a moderate knowledge of chemistry to analyse speedily and exactly the principal minerals.

No. 3 is of a much more popular kind than the two previously mentioned works; its author, M. Girard, is well known as a successful populariser of scientific results. It contains sixty-eight beautiful and useful cuts. It is intended as a handbook to those who wish to derive amusement and instruction from the use of the microscope, and takes up successively some of the principal points in the animal, vegetable (existing and fossil), and mineral kingdoms.

Nos. 1 and 2 have very full indexes appended.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Periodicity of Auroras

ON my return to Newcastle-on-Tyne I take the opportunity of being able to recur to books of reference to reply to a question put by Mr. Procter, in NATURE (vol. x. p. 355), whether any complete catalogues of auroras have been constructed, and if they show indications of periodicity in its displays. Kæmtz's "Meteorology," in which almost every feature of the weather capable of being chronicled has been fully catalogued, probably contains a list more or less complete, up to its author's time, of all then known descriptions of auroras. If this be so, it has probably served for the groundwork upon which later and more complete catalogues have been compiled, extended, and completed in his own and other countries. Dr. Heis, the director of the Prussian Observatory at Münster, in Westphalia, is especially active in collecting information of the slightest appearances of aurora in any quarters of the globe, from whence published or private descriptions of them can be obtained. Every successive number of such works as Mr. G. J. Symons's *Monthly Meteorological Magazine* and the *Quarterly Journal of the Scottish Meteorological Society* contains, in a few pages of "meteorological notes" on the weather peculiarities of each month from their numerous observers, a list of scattered aurora-observations, which is probably as complete for the British Isles during the years in which these publications have been carried on, as the perfect or partial clearness of the sky over this country, and indeed over some adjacent continental stations, enables such a list to be made by observations. But this collection, invaluable as it is for our own immediate field of registry, is not assorted, nor suited, without extension by the help of similar collections made in surrounding foreign countries, to be regarded as a sufficiently extensive list of auroras for dealing generally with the question of their periodicity. The present state of progress of our knowledge, with regard to auroral frequency, we owe largely, if not almost entirely, to the researches of Prof. E. Loomis, of Yale College, U.S., the results of whose discussion of the collateral views and considerations involved in them will be found in numbers of the *American Journal of Science* for July 1860, Sept. 1870, and April 1873. In the first of these papers, a map of lines of equal auroral frequency for the northern hemisphere is presented, dividing the northern area of the globe into zones encircling the arctic regions. It appears, for example, from this map, that auroral displays are not very much more frequently visible in St. Petersburg than they are in London, and that even Boston and Edinburgh are as frequently visited by them as the great northern capital itself. An oval belt of greatest auroral frequency encloses together the north geographical and north magnetic poles, covering all the European, Asiatic, and American coast lines of the Arctic Ocean, and passing onwards from the latter across Hudson's Bay, the mouth of Baffin's Bay, and Iceland, back to the North Cape. For a short distance within this ample belt auroras continue to be tolerably frequent, and grow comparatively more scarce in Smith's Sound and the northern parts of Baffin's Bay, and indeed apparently in proportion as the geographical north polar regions are approached.* It is with the outer and not with the inner margin, however, of this ring-maximum of auroras that observers in ordinary latitudes are concerned, and it is pointed out in his most recent paper by Prof. Loomis, that in constructing general catalogues for deciding questions of auroral periodicity, a line, or at least a restricted zone, bordered northwards and southwards by lines of equal auroral frequency, should be chosen as the localities from which observations may be gathered. To place this line or belt in the zone itself of almost constant auroral activity, where auroras can only vary periodically in brightness rather than in

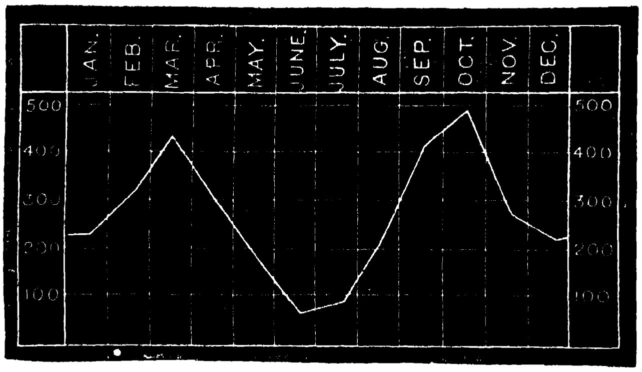

FIG. 1.—Number of auroras observed in each month of the year (Kæmtz).

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* It will be remembered that in Capt. Kane's description of a winter-detention of his vessel in Smith's Sound (the northernmost passage from Baffin's Bay, about eight and-a-half degrees from the north pole), it is related that the feeling of prolonged darkness at length became so oppressive that even the Esquimaux dogs were affected by it, and when excluded from the luxury whined piteously for light. A darkness so deep and enduring as this description suggests can scarcely have been broken, as it occurs in the more favoured belt twenty degrees south of this high latitude, at the mouth of Davis Strait, by the illumination of bright rays and flashing beams of constantly appearing fine auroras. The position occupied by Capt. Kane was not more than two or three degrees from the general centre of the region of fast-diminishing auroral frequency, embracing the whole Arctic Ocean, which is shown on Prof. Loomis's auroral map as merging insensibly on all sides into the broad or narrow belt of greatest auroral activity surrounding it. The latter seems to follow very nearly along its whole extent, with a corresponding strong depression and expansion of its width towards Hudson's Bay, the general direction of the arctic coast-line.

frequency, would be of no avail for enumerations; the zone selected must be one of occasional auroras, arising only from the southward spreading of the strongest disturbances of the ever-beaming and sometimes forth-sallying illuminations of the north.

It is also for such other obvious reasons, as that years of arctic exploration tend to appear in general catalogues as years of extraordinary auroral frequency, and that observations in Asia, Western America, and in the whole of the southern hemisphere have for the most part been made but recently or at very irregular intervals, that the use of general auroral catalogues in questions of periodicity calls for much selection and reduction of the miscellaneous mass of observations. A most extensive general auroral catalogue appears to have been published early last year, or at the end of the previous year,* by Prof. Lovering, of the United States, of which Prof. Loomis has employed the materials, and of which he acknowledges the completeness in terms of commendation. It extends from the year 500 B.C. to the year 1864, and includes with its supplements upwards of 12,000 cases of observed auroras. For the following years, from 1864 to the end of 1872, Prof. Loomis has continued the catalogue for a restricted area suited to the question of periodicity, partly from American sources, and partly (in Europe) from the periodical journal published by Dr. Heis, *Wochenschrift für Astronomie und Meteorologie*. The selected region of observation is limited on the north by an iso-auroral line skirting the northern boundary of the State of Massachusetts and crossing the Atlantic from near Boston to the north of Ireland, passing thence between England and Scotland, and through the northern part of Jutland, a little south of Stockholm, to a little north of St. Petersburg, where it continues its course in Russia as far as long. 40° E. from Greenwich. The meridian of this longitude (nearly that of the eastern ends of the Black Sea and Red Sea) limits the area on the east. It is similarly limited westwards by the meridian of 80° W. from Greenwich, including Washington, and the eastern, but none of the western States of North America. A lengthy general catalogue for this region was extracted by Prof. Loomis from Lovering's list, including all the auroras recorded in it in the years between the beginning of the year 1776 and the end of the year 1872, with their month and dates. The whole of this long list, supplemented in great measure by his own inquiries, is given at full length at the end of the last paper (*sup. cit.*) by Prof. Loomis. The number of auroras in each year, or their annual frequency, is then obtained and laid down in a curve for the whole interval of ninety-six years of the observations. On the same plate is projected the mean daily range of magnetic declination, and the relative extent of black spots on the sun's disc for the same series of years of observation; the latter from Wolff's numbers, and the former from the average of magnetic observations made at Prague from the year 1777 to the year 1871 inclusive. Very uncouth in appearance are all these curves: and the curve of annual auroral frequency is far the most shapeless in outline of them all; but the leading crests and troughs of the ruling eleven-year period of the sun-spot curve are conspicuously reproduced in each of the other two curves, so that it is difficult to say whether the auroral curve or the curve of magnetic declination is the stricter in its adherence to the times of maxima prescribed to it by the solar spots. In two cases, however, the auroral maximum took place some three years, and in another case about a year, too late (1840, 1851, 1871). The maximum of the magnetic disturbance curve also took place on one of these occasions (1838) a year later than the sun-spot maximum, while in the year 1787 both the auroral frequency and magnetic disturbance curves attained their maxima together between one and two years earlier than the sun-spot curve.

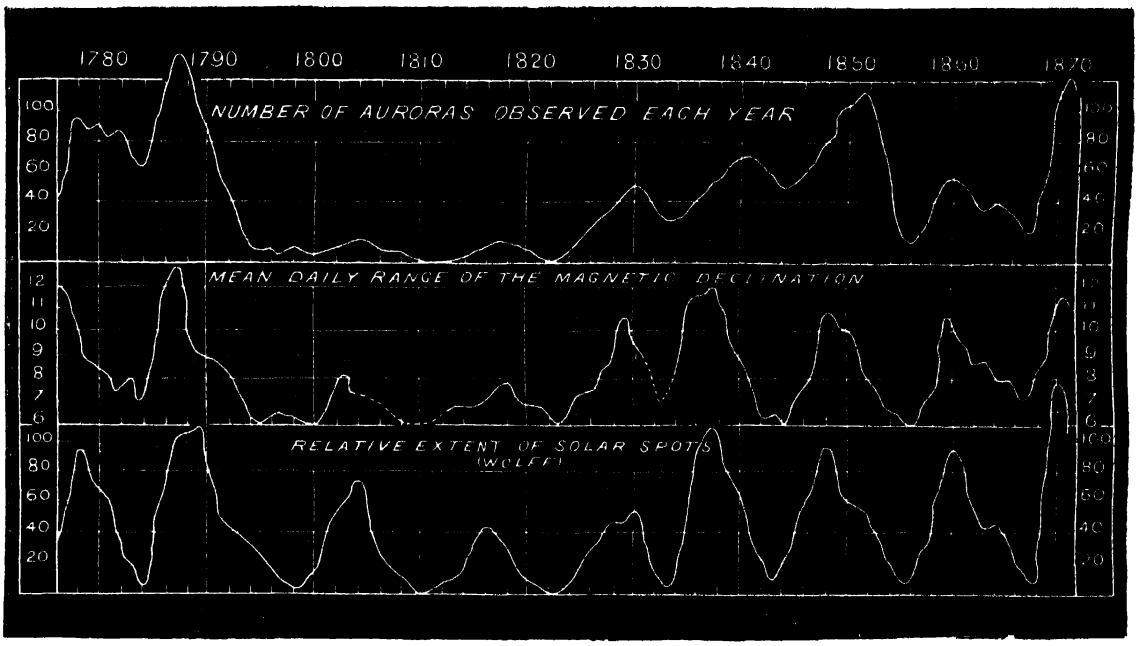

FIG. 2

Prof. Loomis concludes that the times of auroral minimum and maximum frequency happen on an average from half a year to a year later than the same critical times of magnetic disturbance and of the sun's relative obscuration by black spots; that they are more nearly related to the same times for the magnetic daily range than for the sun-spot curve, and that the time of greatest auroral frequency lasts longer than that of the sun's obscuration by spots or of the magnetic needle's greatest daily disturbances. A period of very moderate activity in all the curves is embraced between the maxima of 1788 and 1830, which is particularly noticeable in the scarcity of auroras and in the smallness of the magnetic oscillations in that period. More than 4,000 auroras are included even in the limited selection from Prof. Lovering's catalogue used by Prof. Loomis to establish these results, and yet the interval of ninety-six years (during which the magnetic declination had been continuously observed) to which it is confined proves to be too short to determine certainly the long cycle of activity and repose that seems to govern the times of greatest auroral frequency for years together, in long recurring periods of between half a century and a century. In a previous paper (the second in the *American Journal of Science* above quoted), Prof. Loomis had arrived at all the conclusions of the paper just described from an auroral catalogue of his own construction, of observations in not very northerly latitudes of Europe and in the United States; extending, however, only to the year 1850, the closing year of the magnetical observations at Prague then accessible to him. A period of about sixty years, from the maximum of the year 1790 to that of 1850, was thence concluded, perhaps too confidently, as the real length of this long cycle of auroral frequency.

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* "Memoirs of the American Academy," vol. x.

On turning to Kæmtz's "Meteorology" (translation by C. V. Walker, 1848, p. 458), I find that the author, with his usual exhaustive completeness, has constructed a general list of auroras observed up to his time (about the year 1820), and has established from it certain laws of their periodicity. The list itself, although not given for brevity in the translation, is in all probability contained in the original, and it must embrace upwards of 3,000 cases of auroral occurrences, since a table of about that total sum showing the numbers recorded in each of the several months of the year is given as the most important scientific result of the compilation. The numbers seen in March, September, and October are about half as great again as those recorded in any of the adjacent months, and about twice as great as have been recorded in either of the two mid-winter months of December and January, when the length of the nights is yet most favourable for their registry. That the numbers of auroral displays noted in June and July are relatively very small is easily explained by the length of the twilight in those months in European latitudes, rendering many, that would be conspicuous exhibitions in darker nights, invisible.

The times of greatest annual activity of the auroræ are thus about the seasons of the equinoxes, when the seat of the most direct action of the sun's rays upon the earth's surface is undergoing its most rapid changes during the sun's yearly course; and when nearly the same parts of the earth's surface continue to be heated directly by the sun's rays at the seasons of the winter and summer solstices, there are times of comparative repose and tranquillity among the exhibitions of auroral outbreaks.

Regarding a secular period, Kæmtz's Catalogue appears to have shown nothing positive. "A period of this kind," he writes, "occurred between the years 1707 and 1790, attaining its maximum about the year 1752; since the year 1820 they have again continued to become more numerous." This maximum in the year 1752, and those shown on Prof. Loomis' auroral curve about the years 1780–90, 1850, and 1870–72, agree very ill with each other, or with the return of a constant cycle of long period connecting them together; the succession more nearly resembles that of periods of hot summers, or of cold winters, governed by fixed laws that have not yet been discovered in their returns and durations: and seems to point to causes influencing the production of auroras very similar to those which determine some of the obscurest features of our seasons. Thus, since the commencement of the earliest continuous temperature-records at the Royal Observatory, Greenwich, in the year 1771, the commencement of winter or the arrival of a mean daily temperature of 40° has fluctuated between the months of November and December, apparently from different degrees of prevalence in those months of an annual tide of south-west wind then reaching a maximum in the British Isles. Assuming changes in the strength of this wind to be the cause of the observed fluctuations and of a gradually increasing retardation of winter and secular rise of mean temperature in the months of November, December, and January, noticed by Mr. Glaisher during the first half of the present century, the average course of this phenomenon, when submitted to examination, resembles very closely the general course of the curve of auroral frequency. There was a sensible retardation of the winter season from about the year 1775 to about the year 1790, followed by a marked acceleration from the latter year onwards through nearly the first quarter of the present century, indicating apparently a considerable abatement of south-west, anti-trade, or equatorial currents, on an average, for that lengthened period. The acting cause however returned, and its strength may be gathered from the fact that the mean temperature of the month of December at Greenwich during the twenty-five years from 1825 to 1850 was higher in eight years than that of the month of November, an anomaly which had only taken place thrice in the first quarter of the century. The last occurrences of the same kind, with which I am acquainted, happened in the years 1858, 1861, and 1862; but the strong retardations of winter, noticeable towards the year 1850, were then rapidly disappearing, and it is not improbable that in the further fluctuations that have since followed, a new correspondence between the secular rise of temperature of the months of November, December, and January at Greenwich, and the considerable maximum of auroral intensity reached during the years 1870–1873, may be found to bear out an analogy which is only hazarded here, in the absence of a better working hypothesis, as an apparently real and perhaps not altogether unnatural connection.

With regard to the relative proportion between eastward and westward movements of auroral rays, I know of no observations that have been made that can offer Mr. Procter any additional information. The possibility that auroral streamers may be uprushes of positive or negative electricity to a point of saturation in the highest regions of the atmosphere, followed by downrushes of the same electricity when the exciting cause in the interior or on the surface of the globe subsides, might be well proved by such observations. The existence of the motion shows that the auroral rays diverge sensibly from the earth's lines of magnetic force, probably in the endeavour (whether effectual or not is indifferent to the explanation) of the Aurora Borealis and Aurora Australis to combine and to neutralise each other (perhaps a rare occurrence) across the equator. The strength of the motion of the beams may be some measure of this tendency, and its absence a sign that the aurora is local and of comparatively little generality and extent. It may here be remarked that the annual periodicity of auroras differs entirely from that observed in the average frequency of sporadic shooting stars, which reaches a maximum in August and September, but has a well-marked minimum in March, resembling the single cold of winter and the single heat of summer produced three months earlier, in each year, by the tropical motion of the sun. A marked frequency of auroras on the dates of January 1–3, April 19–21, August 9–11, October 18-21, November 14 and 27, and December 10-12, when meteor-showers of various degrees of brightness are of almost annual occurrence, has not, as far as I am aware, been definitely traced and established; but the large auroral catalogues recently published by Prof. Loomis and Prof. Lovering will, it is evident, supply very valuable materials by which any such connection between auroras and periodical meteor-showers, if it exists, can be more thoroughly investigated and determined.

A. S. HERSCHEL

Automatism of Animals

YOUR correspondent, Mr. Wetterhan, has, I think, misunderstood Prof. Huxley's argument; which is, not that the adjusted motions he refers to never were the result of conscious and voluntary motion, but that they are not so now. His letter has, however, induced me to call attention to what has always seemed to me a real difficulty. As I understand automatic or reflex actions, they are those which have been so constantly repeated and which are so essential to the well-being of the individual, that the various nerves implicated have become so perfectly co-ordinated that the appropriate stimulus sets the whole machinery in motion without any conscious or voluntary action on the part of the individual. Thus we can quite understand how a paralysed limb would be drawn up when the sole of the foot is tickled or the toe pricked. If, however, any such irritation continues to be felt in the normal state, a man would stoop down and remove the irritating substance with his hand, or would place his foot upon the opposite knee, and, stooping down, endeavour to *see* the object which caused the irritation. But these are *conscious*, not *reflex*, acts. They are not repeated often enough, and are not sufficiently identical in form, to become automatic; and we are not told that a wholly paralysed human body does actually go through these various motions, as it certainly would do if not paralysed.

Now, in the case of the frog I can quite understand the jumping, swallowing, swimming, and even the balancing; for all these are actions so essential to the animal's existence, and so often repeated during life, as to have become automatic. So, also, I can understand the drawing up of the foot to remove an irritation on the side of the body, for with the short-necked frog this too is an essential, and must have been an oft-repeated action. But we are further told that "if you hold down the limb so that the frog cannot use it, he will, by and by, take the limb of the other side and turn it across the body, and use it for the same rubbing process." Now, this seems to me not to be explicable by automatic or reflex action, because it cannot have been an action frequently if ever performed during the life of every frog. It is true that from the co-ordination of the movements of the opposite limbs, we might expect, if the irritation were continued, and the leg on the same side kept for some time in motion, that the other leg would begin to move *in the same way*. But what causes it to move in a quite different and unusual way, *across* the body to the opposite side; and this, as related, at once and without first trying its own side? The most usual motion of both legs is directly up and down, each on its own side. What is it that causes one of these legs, when it begins to move, not to move in the usual way (that which is automatic during life), but in an unusual manner, which must have been very rarely, if at all, used during life, and when used must have been purely conscious and voluntary? I think I cannot be mistaken in considering this to require some explanation. It may be that the frog is constantly, during life, crossing one foot over to rub the opposite side of the body; but we cannot accept this as an explanation unless it has been observed to be a fact. What puzzles me is, that Prof. Huxley, Dr. Carpenter, and Mr. Darwin, all refer to this case as an example of reflex action, and none of them see any difficulty in it, or seem to think that it requires any more explanation than the remaining quite intelligible cases. As others may, like myself, feel the difficulty I have endeavoured to point out, I hope some of your physiological correspondents will enlighten us if they can.

ALFRED R. WALLACE

Supernumerary Rainbow

IN Mr. Backhouse's letter (NATURE, vol. x. p. 437) he remarks that the supernumerary rainbow is commonly seen only in the upper part of the arch. Dr. Thomas Young, in his Bakerian Lecture ("Works," vol. i. p. 185, or Phil. Trans. 1804), after explaining the supernumerary bow by interferences, quotes a paper in vol. xxxii. of the Phil. Trans., in which Dr. Langwith describes his observation of a supernumerary bow on August 21, 1722; then remarks: "I have never observed these inner orders of colours in the lower parts of the rainbow. I have taken notice of this so often that I can hardly look upon it as accidental; and if it should prove true in general, it will bring the disquisition into a narrow compass; for it will show that this effect depends upon some property which the drops retain whilst they are in the upper part of the air, but lose as they come lower and are more mixed with one another." But I am not aware that anyone has ever remarked an appearance which struck me on seeing a few days ago a very complete primary and secondary bow with a portion of two supernumerary bows within the primary and about the highest part of the arch. To my eye the supernumerary bows were *not concentric* with the primary. My son agreed with me as to this appearance when I pointed it out to him; yet I thought it was probably an illusion till the following explanation occurred to me.

The rain-drops may be presumed to be smaller high in the air, and to increase as they descend.

Now, the smaller drops produce wider interference fringes than the larger drops do. Hence the supernumerary bow is widest and therefore farthest from the primary at the top of the arch, and gets narrower and nearer to the primary as it descends the arch on each side, and "in the lower parts" ultimately fines away to nothing. According to this theory the supernumerary bow is not always concentric with the primary, nor indeed circular.

It should be observed that another reason for the interference bow being seen most frequently at the highest part of the bow is that the small drops high in the air are probably more uniform in size than the larger drops lower down.

Oct. 8 JOSEPH BLACKBURN

Colour in Flowers not due to Insects

THE doctrine that the conspicuous colours of flowers are entirely due to the necessity for cross-fertilisation by the agency of insects seems to be taking the world by storm. It is supported by Mr. Darwin and Sir John Lubbock. It could scarcely be put forward on better authority. Yet there are several facts with which it does not harmonise. For instance—

1. *Cultivation* increases the size and colour of flowers quite independently of the existence or non-existence of insects.

2. *Double flowers* in which the doubling arises from metamorphosis of stamens or pistils are more showy than the single forms, yet insects can be of little use to them, since they are either partially or entirely barren. The double-blossomed cherry is brilliantly conspicuous, but it bears no fruit.

3. Such *abortive flowers* as the cultivated Guelder Rose and Hydrangea depend for their beauty upon the destruction of the reproductive organs. If their increased splendour is meant only as a lure to insects, it is surely an absurd failure.

4. The *autumn colours* of leaves and fruits can serve no such purpose, yet these are often as bright and conspicuous as the flowers of summer.

5. *Fungi* and *lichens* exhibit brilliant colours, which can have nothing to do with insect-fertilisation.

Do not these facts indicate that though insects may be attracted by conspicuous colours, and may have some influence in the maintenance of coloured species, there is yet a deeper and more permanent cause for the colour itself?

Leicester, Oct. 11. F. T. MOTT

Habits of Squirrels

WOULD you permit me to ask of your readers a question or two upon the habits of squirrels? I have had one in my possession, from the age of three weeks, for more than two years. I have noticed that whenever it cleans itself, after licking, it *sneezes* violently three or four times into its forepaws, then rubs them thus damped over its fur. It seems to have the power of sneezing at volition.

Now, is this habit of sneezing, for the purpose of cleaning itself, a habit peculiar to squirrels; or is it shared by other animals?

I notice also that frequently when it is going thoroughly to clean itself it jerks its forepaws over its ears, bringing them back over its eyes, and always causing a milky liquid to suffuse the eyes. This liquid swims over the eye, and then is absorbed. I have thought that it may use this secretion also for the purpose of moisture. The animal is in perfect health and splendid condition.

A squirrel I had three years ago also had this habit, though in a slighter degree. D. T.

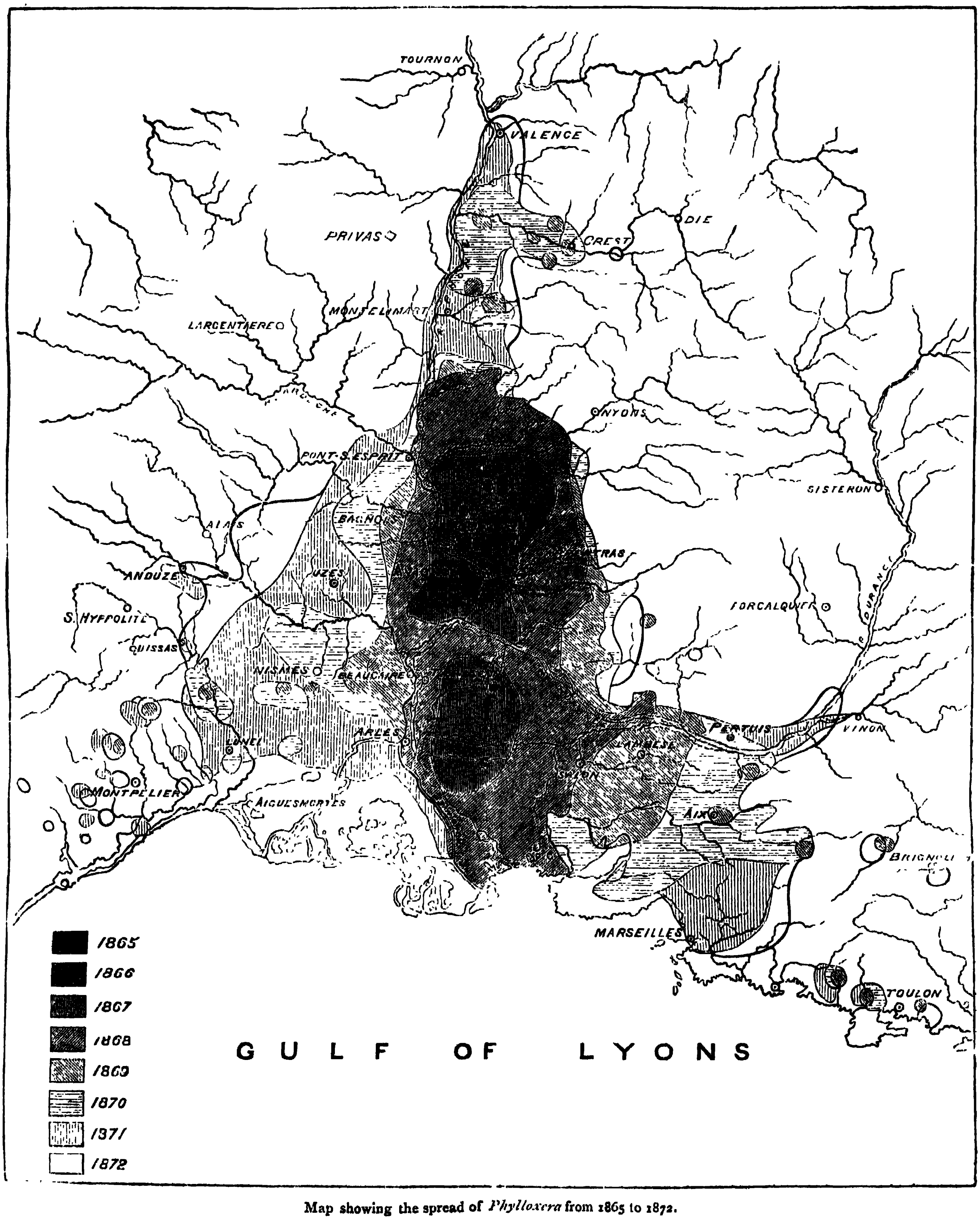
THE NEW VINE-DISEASE IN THE SOUTH-EAST OF FRANCE

I.

WE have before us the Reports presented to the French Academy of Sciences by the delegates of the Commission appointed by that body to investigate the phenomena of the new and terrible disease of the vine in the south-east of France—a disease which is fraught with the most serious consequences to the material prosperity of that country, which depends on its wine as a source of national wealth not less important than are our coal and iron to us.

It was in the autumn of the year 1871 that the Academy of Sciences directed special attention to the communications which poured in upon it from all quarters relative to the ravages of the new parasite of the vine in the South of France; and at the sitting on the 25th September in that year, it charged a Commission, consisting of M. Dumas as president, MM. Milne-Edwards, Duchartre, and Blanchard, to investigate the means of coping with the disease. The Commission examined with the greatest care all the manuscripts and printed monographs which were brought under its notice, and paid particular attention to the scrutiny of the leaves and the roots attacked by the *Phylloxera vastatrix* (for such is the name which has been given to the new insect), which had been sent to it from different places in France; and, with the object of giving to its labours the active direction necessary in such circumstances, it decided to confide the execution of them to three delegates, viz. MM. Balbiani, Max Cornu, and Duclaux, whose learned researches in zoology, botany, and chemistry, suggested recourse to them, and they were accordingly charged with the pursuit of all the observations which the subject would allow of, on the actually affected territory.

It is worth our while, at the outset, to observe the thorough and methodical manner in which an attempt has been made to wrestle with this new enemy of the material welfare of France, and the application of the resources of science to unravel as exhaustively as possible the causes and manner of extension of the invasion of the parasite from its first appearance till the present time. We in England are too apt in similar crises to neglect the practical employment of scientific means, to depend on private and individual exertions for the investigation and treatment of the different causes which threaten the national wealth or prosperity; and though in the long run perhaps we come out of the difficulty in a manner not altogether unsatisfactory, still such result can only be obtained at the xpense of interests to which speedy action and promp methodical treatment are the only means of preservation· But in France and in most of the continental countries of Europe, the State, or at least important corporate bodies, come quickly to the aid of science, which, thus subsidised and encouraged, can penetrate far deeper and can have a freer play for its researches. As a result, in the present case we have the studies of men of science on this subject of altogether national importance, studies which, if we mistake not, should go far to direct the efforts of the nation into the right course of treatment for the extirpa-



Map showing the spread of *Phylloxera* from 1865 to 1872.

tion of this alarming scourge, which has destroyed the produce of so many of the fairest vineyards of the south-east of France.

It is a matter of no difficulty to master the history of the new disease produced by the *Phylloxera*, and to trace its growth from the earliest beginnings. The first definite signs of the invasion of the parasite were observed in the year 1865, at a spot (plainly marked in the maps annexed to the report of M. Duclaux, and now copied for our readers) on the plateau of Pujaut, near Roquemaure, in the neighbourhood of Avignon, and in the department of the Gard, on the west bank of the river Rhône. Though in this year it attracted but little attention, in 1866 it descended rapidly from the plateau to the outskirts of the village of Roquemaure, and also appeared in several spots in the departments of Vaucluse and the Bouches du Rhône, both lying on the east side of the river-valley. It was the owner of a vineyard in this latter department, a M. Delorme, of Arles, who was the first to recognise the disease, while still in the birth, as a new disease, and to have the presentiment of the disasters which would follow in its train. At a later period a commission of the Society of Agriculture of the Hérault visited by request the vineyards around Saint-Rémy, and a member of that commission, M. Planchon, discovered that the cause of the vine-disease was an insect "destined to be the subject of so much discussion, and to become the source of so much misery." It was he who afterwards gave the parasite the name which it has since borne everywhere—*Phylloxera vastatrix*.

Before proceeding to describe the ravages of the insect and the manner in which it ultimately causes the death of the vine, it will be well to show the progressive extension of the disease itself over the country adjacent to the Rhône valley and lying inland to the north of the Gulf of Lyons. M. Duclaux has shown us, in his series of maps annexed to his report, the progress of the disease between the years 1865 and 1872, and marks it as gradually extending from the little spot first attacked in the neighbourhood of Avignon till in the last of those years it included the whole country between Valence on the north and Marseilles on the south, while westwards and eastwards it extended to Montpellier and Aix respectively, thus covering, roughly speaking, nearly four departments, viz., the Gard, the Drome, Vaucluse, and Bouches du Rhône. We are told in the memoir of M. Louis Faucon, also presented to the Academy of Sciences, and embracing a later period than that of M. Duclaux, that the disease extended to an alarming degree in the year 1873, at the same or a greater progressive rate, and had established itself in that year in no less than twelve departments of South-east France, having spread into the Ardèche, the Basses-Alpes, Var, Isère, Hérault, and even reaching so far as the Gironde and the two Charentes.

We may gain a more precise idea than can be afforded by a mere observation of the geographical extension of the disease, of the disastrous nature of the ravages of the *Phylloxera*, by the examination of some of the statistics of the grape-crop in successive years in some of the departments attacked. Thus, in the department of Vaucluse, where the disease showed itself in 1866, there were in 1869, according to the results obtained by the departmental commission instituted at Avignon to observe on the new vine-disease, 6,000 hectares absolutely dead or dying, and a much larger number already attacked, which have since succumbed to the parasite. Out of the 30,000 hectares of vineyard comprised in this department, 25,000, or five-sixths of the total area, have been destroyed. In the Gard, where the vine flourishes better than in the above-mentioned department, the ravages of the disease are yet most terrible, for in 1871, in the arrondissement of Uzès, but one-half of the average crop was produced, and in the arrondissement of Nismes, a tenth part of the crop was destroyed. These proportions, moreover, have increased since that year.

If we examine the mischief done in the less extended areas of the communes, we shall obtain a still clearer idea of the rapid spread of the disease :—

COMMUNE OF GRAVESON.

1865-66-67	mean crop	10,000	hectolitres
1868	"	5,500	"
1869	"	2,200	"
1870	"	400	"
1871	"	250	"
1872	"	100	"
1873	"	50	"

In the commune of Maillanne the crop in 1868 was only 40 per cent. of the average of the three preceding years, while in 1869 it was only 10 per cent. In the commune of Eyragues the crop in 1868 was about 33 per cent. of the average of the three preceding years, and in 1869 there was a further falling off of about 10 per cent. In 1870 the crop in the three above-named communes was almost entirely destroyed. From instances such as these, fairly selected from many others equally tragic in their stern figures, we may form some idea of the magnitude of the disaster. Indeed, it is difficult to see, so rapid is the extension of the disease, how, unless some potent and effective remedy can be soon applied, any vine-bearing district in France can escape the visitation of the *Phylloxera*.

Though there can be no doubt that the *Phylloxera* is the cause of the new vine-disease, this conviction was by no means arrived at at once, nor without considerable doubts being thrown upon it by those whose better judgment was obscured by the confusion of concomitant phenomena such as drought, cold, and impoverishment of the soil with the real source of malady of which they were the companions. Others, even now, hold that the *Phylloxera* is the effect and not the cause of the disease; this idea M. Faucon dissipates satisfactorily in his treatise by the following reasoning :—A vine is watched which is in a perfect state of health and vigour; not a single parasite is discovered in the ramifications of its roots. A day comes when the destructive insect invades it—it resists for some time; the *Phylloxera* lays its eggs, multiplies its numbers, and with them its attacks. The stem of the vine begins to show signs of the disease, and if the roots are laid bare, they may be observed to have deteriorated in some degree from their normal state. The multiplication of the insect continues, and assumes such proportions as to form yellow spots of no small size, the result of the close collection of a large number of the insects, whose puncturings are so numerous and so incessant that the roots can no longer perform their proper function, the nutrition of the plant, which, in consequence, falls into a most evident state of sickliness, lingers on for some time, and eventually dies. The *Phylloxera* takes its first food where it can get it with the least difficulty. After it has exhausted the surface rootlets, tender and succulent as they are, it attacks others deeper down; then it spreads over the hardier roots, till at last the prodigious increase of its family causes it to overrun the whole radical system of the plant, and even the part of the stock of the vine which is underground. It abandons the exhausted plant when it is of no more use to it, and its instinct turns its steps towards a new vine, where it can find fresh food. The work of destruction in a vine, especially if it be vigorous and the soil nutritious, is not completed in a few days. A year may pass without the vine exhibiting any marked sign of sickness. The store of vigour which it contains in itself, added to that which it imbibes for some time after it is attacked in the soil, will permit it during one or even two seasons to perform the double functions of nourishing both itself and the parasite which eventually destroys it. M.

Faucon's observations, confirmed by those of all the other persons who have made positive investigations for themselves, have established that:—

1. The number of insects on a plant is in direct and constant accordance with the state of the roots.
2. According as the state of the roots is healthier, is the number of insects greater.
3. The number diminishes in proportion to the exhaustion and consequent death of the roots.
4. On an absolutely dead plant it is impossible to discover a single insect. Surely, therefore, the *Phylloxera* is the cause, and the only cause, of the vine-disease, since its appearance invariably precedes the rotting of the roots, and never follows on their decay.

We postpone till next week the description of the *Phylloxera* itself and the manner in which it attacks and ultimately kills the vine, together with the mention of the various means which have been proposed for the extirpation of the disease.

(*To be continued.*)

PHYSICS AT THE UNIVERSITY OF LONDON[*]

At the present time, when the bulk of the educated population of many countries may be divided into the three classes of *Examinandi*, *Examinati*, and *Examinatores*, a large part of any discussion of what is called the higher education must inevitably be devoted to the question of examinations. Usually, if the matter is discussed from the point of view of those whose business it is to teach, the result is the condemnation of examinations in general as unfavourable to all thorough study; and, from whatever quarter the discussion proceeds, it seems to be taken for granted that the functions of the teacher and those of the examiner are naturally opposed to each other. And indeed no one who has given any attention to the question can doubt but that such an opposition really does exist in very many cases. Originally employed by teachers themselves to consolidate and test the results of their instruction, examinations were at first a natural part of the educational system; but of late years they have rapidly developed into an independent species, which has separated off from the parent organism and now too often tyrannises over it. As of other developments, so of this, we are bound to believe that it is an adaptation to co-existing conditions, and therefore fulfils some useful purposes; but, from the teacher's point of view, as soon as examinations become detached from instruction, and come to be the end of learning instead of a means of teaching, the evils they produce are much more apparent than these benefits. When they have no worse result, they are apt to be viewed by students as affording them an authoritative standard, independent of the judgment of their professors, by which to decide what subjects of study and what parts of these subjects are of sufficient importance to be worthy of their attention. It is therefore not to be wondered at that such examinations should be looked upon by teachers with dislike, as being hindrances and not helps to their work, or that we should hear frequent protests against their excessive multiplication.

While, however, I in general heartily sympathise with such protests, and feel strongly that the difficulty of honest and thorough teaching in my own subject is greatly increased by the regulations for those examinations which, in fairness to the students attending my lectures, I am bound not to lose sight of, it does not seem to me that the remedy for the evils complained of is to be looked for in the abolition of the present examination system. This system is no doubt defective in many ways, and we may perhaps hope that some day it will be replaced by one more accordant with sound educational principles; for the present, however, it exists, and must be recognised as one of the conditions under which our work has to be done. Practical wisdom therefore teaches that instead of trying to get rid of it, we should strive as far as possible to improve it, to lessen its faults, and to develop whatever good it may be susceptible of.

It is admitted on all hands that examinations carried on in direct connection with teaching are of great educational value, of so much value indeed that no careful teacher ever thinks of doing without them. What, therefore, in the interests of sound education, we ought to strive for, in relation to those examinations which are not connected with any system of instruction, is that they should be made, as nearly as possible, what they would be if they did form part of such a system. It is perhaps too much to expect that this should be taken as the leading principle in the case of examinations such as those, now so common in connection with various branches of the public service, which exist for the primary object, not of promoting education, but of preventing dolts and dunces from being supported at the public expense; but, besides these, there are many examinations nowadays, which, though unconnected with teaching, are professedly intended for the advancement of education. Among such examinations, those of the University of London are on many accounts the most important, and the intimate relation between them and much of our work in this College seems to me to be a sufficient reason for considering how far the influence which, through this relation, they exert upon our teaching, is beneficial or otherwise.

If any further justification be needed for discussing the educational tendency of the examinations of the University of London, beyond the general one arising from the paramount importance of the improvement of education, it may be found in the history of the University. It is doubtless known to many of my audience that the University of London was constituted, in most essential respects as it now exists, by a Royal Charter dated December 5, 1837, in order, "for the advancement of religion and morality, and the promotion of useful knowledge, to hold forth to all classes and denominations of [her Majesty's] faithful subjects, without any distinction whatsoever, an encouragement for pursuing a regular and liberal course of education." The form which this encouragement was to take was that of "ascertaining, by means of examination, the persons who have acquired proficiency in Literature, Science, and Art, by the pursuit of such course of education, and of rewarding them by Academical Degrees, as evidence of their respective attainments, and marks of honour proportioned thereto;" and it was directed that all persons should be admitted as candidates for degrees in Arts and Laws, who should produce certificates of having completed the course of instruction prescribed by the University either in *this* College or in King's College, London, or in any other such institution as might be authorised by the Crown to issue such certificates. But in 1858, the Senate of the University obtained a new charter by which they were empowered to admit candidates to the examinations for degrees in Arts, Laws, Science, and Music without requiring them to have previously pursued any prescribed course of study, or to have attended any particular place of instruction; and since that time no other qualification has been demanded of graduates of the University of London (with the exception of those who have taken degrees in Medicine) than the ability to pass the appointed examinations. I do not now propose to discuss the question whether the passing of an examination only affords as good ground for conferring academical distinction as the passing of the same examination combined with studentship at some recognised college or other educational institution; my object at present is simply to draw attention to the fact that the University of London, created in order to encourage the pursuit of "a regular and liberal course of education," no longer requires candidates for degrees in Arts or in Science to pass through any collegiate course, but considers that she sufficiently fulfils her mission by devising and carrying out into practice a system of examinations. It appears to me that this fact justifies all who are interested in the progress of sound education in demanding that these examinations should be so arranged as to encourage to the utmost possible extent thorough study and conscientious teaching.

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[*] Introductory Lecture delivered at the opening of the Session of the Faculties of Arts and Laws and of Science, in University College, London, on Monday, Oct. 5, 1874, by G. Carey Foster, F.R.S., Professor of Physics.

The present Regulations of the University do not in all cases seem to me to fulfil this condition as completely as they might do, and I therefore think that I may suitably make use of this opportunity for trying to point out their defects as definitely as I can, and for attempting, if possible, to suggest improvements. I need hardly say, however, that whatever criticisms or suggestions I may venture to make will refer almost exclusively to the Regulations affecting that branch of science, namely Physics, with which I am specially connected. I believe, nevertheless, that the general principles which it is of greatest importance to keep in view in framing an examination in any department of knowledge are very nearly the same, and therefore I venture to hope that if the reflections which my experience of the London University examinations, both as an Examiner and as a Teacher, has suggested to me, are of any value in relation to my own subject, they may not be quite worthless in relation to others.

In order to apply to the case of Physics the general principle that examinations and direct teaching ought to be only different ways of attaining the same object, it is needful to consider first of all what reasons there may be for including the study of Physics in "a regular and liberal course of education," and what ought therefore to be the aim of teacher and examiner alike. With regard to this point, it will probably be admitted that the educational value of the study of Physics depends upon the mental discipline which it ensures, and not upon the individual facts, or even on the general laws, with which it stores the memory. It follows from the nature of the phenomena with which this science deals, that, to a much greater extent than has hitherto been the case with the phenomena of any other branch of science, the exact conditions of their occurrence have been ascertained, and the relations which they bear to one another have been expressed by definite numerical laws. In consequence of the precision which it is hence possible to give not only to statements respecting individual physical phenomena, but also to statements involving general laws, the reasoning by which the conclusions of Physics are established assumes a stricter character than can be attained in any other branch of natural science. It may be confidently asserted that, for training the mind in habits of accurate thinking, no other study can be compared with that of Physics if properly pursued; for, while it affords abundant practice in deductive reasoning of mathematical strictness, it obliges us to give no less attention to the converse process of inferring general laws from particular concrete phenomena and the direct impressions which they make on our senses. It is this combination of deductive with inductive reasoning which constitutes the special value of the study of Physics for the purposes of mental discipline. It is quite true that the deductive processes of Physics are borrowed from Mathematics, and that it shares the inductive method with all the other branches of natural science; but the greater definiteness of physical phenomena, as compared with those of other sciences, not only, as I have already said, leads to a greater definiteness in our general conclusions respecting them, but, as a further consequence, makes it easier to test the truth or falsehood of their conclusions by comparing the results deductively derived from them with the results of new experiments or observations. It may even, indeed, be thought that the comparative definiteness and precision of the problems with which the science of Physics is concerned render the study of it less serviceable, as a preparation for dealing with the complex questions which arise in the common experience of life, than the study of sciences in which the uncertainty and indefiniteness of the data leave a greater scope for the exercise of a judicious tact in the estimation of probabilities; but to maintain such an opinion would be very much like saying that in order to become familiar with the laws of chemical action and the nature of chemical combination, we ought to study the transformations of albumen and chlorophyll rather than the properties of such things as potassium, oxygen, or sulphuric acid. It is of course because physical phenomena are simpler and more accessible to investigation than those of Chemistry or Biology, that greater progress has been made in the study of them, and that the explanations that have been reached are of a higher degree of certainty and generality; but it is precisely the relatively advanced stage which has been reached by it that gives to the study of Physics its high value as an element in general education, and is the reason why it furnishes us with fuller and more instructive examples of scientific reasoning than other sciences.

The nature of the intellectual benefits that have been pointed out as resulting from this study, suggests at once the conditions that must be fulfilled in order to obtain them. If in studying Physics we really undergo, as I have said, a process of training to think correctly, this can only be through the exercise of our minds in following the demonstrably correct trains of thought whereby the general conclusions of Physics have been derived from the observed facts, and through our becoming so familiar with them that, consciously or unconsciously, we take them for our models, whatever may be the subjects to which we require to direct our minds. It follows from this that these benefits do not depend upon the direct results of experiment or observation with which the study makes us acquainted, nor upon the general laws of nature which it reveals to us, but upon the reasoning processes whereby facts and laws are connected together and both are made part of the living body of science. And from this again we see that the kind of teaching and study to be aimed at is that which enables us to trace these processes step by step and to understand their validity; while the kind to be anxiously avoided is that which stores the memory with detached pieces of information, either in the form of facts whose mutual relations are not perceived, or in the form of theoretical conclusions hung up between heaven and earth, and supported neither by revelation from above nor by demonstration from below. This latter, however, is the kind of teaching so much in demand and so frequently offered, which is known by the name of "cramming."

By way of guarding against misconception, it may be well to point out—what, however, is exceedingly obvious—that there can be no reasoning about Physics until the facts of Physics are known, and therefore that the teaching of these facts must always occupy an important place as the indispensable groundwork of all that is to follow. But still it must be remembered that, so long as we are considering the study of Physics merely as a part of general education, the facts of the science are of importance only in relation to the reasoning that is based upon them. Taken by itself, one bit of information is of about as little use in developing the mental powers as any other; it does us about as much good to be told that "heat is a mode of motion" as that "the Government of England is a limited monarchy," and to know the difference between a thermometer and a barometer enlarges the mind to about the same extent as to know how to distinguish a pitchfork from a Dutch hoe.

We may now return to consider the effect of the examinations of the University of London upon the teaching of Physics. These examinations, as we have seen, exist for the express purpose of encouraging the pursuit of "a regular and liberal course of education," or, as it may be otherwise expressed, in order to encourage good teaching and to discourage bad; and in the foregoing remarks I have tried to show as definitely as I can what meaning is to be attached to the words "good" and "bad" in relation to the teaching of Physics. The obvious conclusion, applicable to the particular point to which I now wish to ask your attention, is that examinations are to be regarded as *good* if they induce candidates to *think* about the mutual relations of individual facts and their connection with general principles; while examinations are *bad* in proportion as they lead to the loading of the memory with unconnected scraps of knowledge.

There are two ways in which the examinations of the University of London tend to affect the quality of teaching for good or for evil: first, by the general Regulations drawn up by the Senate in reference to the various examinations, including the list of subjects to be taken up and the specifications of the requirements in each subject; and secondly, the questions set by the Examiners, which form as it were a detailed commentary, authorised by the Senate, on the meaning of their own Regulations. For various reasons, the lowest examinations, or those which come earliest in the University scheme, produce the greatest effect on methods of teaching and learning; for one thing, they affect the greatest number of candidates, and they come at a part of the candidates' career when they are most dependent on external authority or advice as to the course of their studies.

THE BIBLIOGRAPHY OF SCIENCE

THERE can be no surer indication of the universal spread of science during the last few years than the large and annually increasing number of works relating to its various branches that are advertised for publication during each successive season. The considerable element which science now forms in education, in the arts and manufactures, in commerce and agriculture, and in the social economy of life, renders the knowledge of at least its rudiments absolutely necessary in almost every sphere of existence. The particulars given below will show that publishers are fully alive to the importance and value of good works in this department of literature.

Although even now we have a large quantity of educational books of varying degrees of mediocrity and excellence in almost all the commoner branches of science, and the number of works is ever increasing, yet the advance made by science makes it imperative that fresh manuals and class-books and new editions should be continually published, in order that students and workers should be enabled to keep pace with its rapid strides. The works we notice beneath range from the smallest general primer to the most elaborated and matured works in particular and specific branches of science; and among them will be found books by men of the highest reputation in their special provinces. We have endeavoured to notice every work of importance which is to be published during the next few months; but our list is necessarily incomplete; we shall, however, in future numbers note any deficiencies, omissions, or fresh announcements.

In ASTRONOMY we observe the following books:—*The Moon*, and the Condition and Configuration of its Surface, by Edmund Neison, Fellow of the Royal Astronomical Society, &c., illustrated by maps and plates. (Longmans.)—*A Primer of Astronomy*, by J. Norman Lockyer, F.R.S., with illustrations. (Macmillan.)—A new edition of *Navigation and Nautical Astronomy*, in theory and practice, by Prof. J. R. Young. (Lockwood.)—*The Transits of Venus*, a Popular Account of Past and Coming Transits, from the first observed by Horrocks, A.D. 1639, to the Transit of A.D. 2112, by Richard Anthony Proctor, B.A. Cantab., Hon. Fell. King's Coll. Lond., with twenty plates and numerous woodcut illustrations. (Longmans.)

In CHEMISTRY we are promised a new edition of *Dr. Normandy's Commercial Handbook of Chemical Analysis*, enlarged and almost re-written by Dr. H. M. Noad, Ph.D., F.R.S. &c., with numerous illustrations. (Lockwood).—A second edition of *Plattner's Manual of Qualitative and Quantitative Analysis with the Blowpipe*, from the last German edition, revised and enlarged by Prof. Th. Richter, of the Royal Saxon Mining Academy, translated by Prof. H. B. Cornwall, Assistant in the Columbia School of Mines, New York; this work is illustrated with eighty-seven woodcuts and one lithographic plate. (Sampson Low.)—*Industrial Chemistry*, a Manual for Manufacturers and for use in Colleges or Technical Schools, being a translation by Dr. J. D. Barry, of Professors Stohmann and Engler's German edition of Payen's "Précis de Chimie Industrielle;" edited throughout and supplemented with chapters on the Chemistry of the Metals, by B. H. Paul, Ph.D., with very numerous plates and woodcuts. (Longmans.)—A third enlarged edition of *A Systematic Handbook of Volumetric Analysis*, or the Quantitative Estimation of Chemical Substances by Measure, applied to Liquids, Solids, and Gases, with numerous engravings, by Francis Sutton, F.C.S., Norwich. (Churchill.)—*The Chemical Effects of Light and Photography, in their Application to Art, Science, and Industry*, by Dr. Hermann Vogel. (King and Co.)—A new edition, revised and enlarged, of *Practical Metallurgy*, by John Percy, M.D., F.R.S., Lecturer on Metallurgy at the Government School of Mines. Vol. I., Part 1. Introduction; Fuel, wood, peat, coal, charcoal, coke, refractory materials, fire-clays, &c. Vol. I., Part 2. Copper, zinc, brass. (John Murray.)

In PHYSICS and MECHANICS, Messrs. Longmans will publish the three following books:—*The Elements of Physics*, by Neil Arnott, M.D., F.R.S., the seventh edition, revised from the author's notes and other sources, and edited by Alexander Bain, LL.D., Professor of Logic in the University of Aberdeen, and by Alfred Swaine Taylor, M.D., F.R.S., Professor of Medical Jurisprudence, Guy's Hospital.—*Introduction to Experimental Physics, Theoretical and Practical*, including directions for constructing physical apparatus and for making experiments, by Adolf F. Weinhold, Professor in the Royal Technical School at Chemnitz, translated and edited (with the author's sanction) by Benjamin Loewy, F.R.A.S, with a preface by G. C. Foster, F.R.S., Professor of Physics in University College, London, with numerous wood engravings.—*Lessons in Elementary Mechanics*, introductory to the Study of Physical Science, by Philip Magnus, B.Sc., B.A. This book is adapted to the requirements of the London Matriculation, Preliminary, Scientific, First M.B., and other Examinations.

Messrs. Charles Griffin will issue *A Mechanical Text-Book*, a Practical and Simple Introduction to the Study of Mechanics, by William John Macquorn Rankine, C.E., LL.D., F.R.SS., &c., late Regius Professor of Civil Engineering in the University of Glasgow; and Edward Fisher Bamber, C.E.

In BIOLOGY we have a large number of new books and new editions, of which the following are the most noteworthy:—*The History of Creation*, by Prof. Ernst Haeckel, the translation revised by E. Ray Lankester, M.A. (King and Co.)—*Elements of Human Physiology*, by Dr. L. Hermann, Professor of Physiology in the University of Zurich, translated and edited from the sixth (yet unpublished) German edition, at the author's request, by Arthur Gamgee, M.D., F.R.S., Brackenbury

Professor of Practical Physiology and Histology in the Owens College, Manchester. (Smith, Elder, and Co.)—*Outlines of Animal Physiology*, with engravings on wood, by W. H. Allchin, M.B., M.R.C.P., Assistant Physician to the Westminster Hospital and Lecturer on Practical Physiology, Histology, and Pathology in its Medical School. (Churchill.)—*Notes of Demonstrations on Physiological Chemistry*, by S. W. Moore, F.C.S., Joint Demonstrator of Practical Physiology at St. George's Medical School. (Smith, Elder, and Co.) This work is nearly ready for publication.—The same publishers announce *The Pathological Anatomy of the Nervous Centres*, by Edward Long Fox, M.D., F.R.C.P., Physician to the Bristol Royal Infirmary, with illustrations; and a *Text-Book of Pathological Anatomy*, by John Wyllie, M.D., F.R.C.P.E., Lecturer on General Pathology at the School of Medicine, Surgeons' Hall, Edinburgh, &c.

We are glad to see that Messrs. Churchill have in the press a fifth and revised edition of Holden's well-known work on *Human Osteology*, comprising a Description of the Bones, with Delineations of the Attachments of the Muscles, &c.—The three following new works also belong to the same publishers:—*Frey's Manual of the Histology and Histo-Chemistry of Man*, a Treatise on the Elements of Structure and Composition of the Human Body, for the use of Practitioners and Students, largely illustrated with engravings on wood, translated by Arthur E. J. Barker, I.R.C.S.I., and revised by the author.—*The Student's Guide to Human Osteology*, with numerous lithographic plates, by William Warwick Wagstaffe, F.R.C.S., Assistant Surgeon and Lecturer on Anatomy at St. Thomas's Hospital.—*The Student's Guide to Practical Histology, Histo-Chemistry, and Embryology*, with engravings on wood; by H. A. Reeves, F.R.C.S. Edin., Assistant Surgeon and Demonstrator of Anatomy at the London Hospital.

The only other book we notice in this branch of science is a new edition of *Demonstrations of Anatomy*, being a Guide to the Knowledge of the Human Body by Dissection, by George Viner Ellis, Professor of Anatomy in University College, London, with 248 engravings on wood. The number of illustrations has been largely added to in this edition, and many of the new woodcuts are reduced copies of the plates in the author's work, "Illustrations of Dissections." (Smith, Elder, and Co.)

In GEOGRAPHY and TRAVELS, probably the works most looked for are *The Last Journals of Dr. Livingstone, in Eastern Africa, from* 1865 *to his Death*, continued by a narrative of his last moments and sufferings, taken down from the mouth of his faithful servants Chuma and Susi, edited by Rev. Horace Waller, F.R.G.S., Rector of Twywell, Northampton, with a map prepared on the spot by the author, and illustrations from his sketches. (Murray); and Sir Samuel Baker's new book, which is entitled *Ismailia*, a Narrative of the Expedition to Central Africa for the Suppression of the Slave Trade, organised by Ismail, Khedive of Egypt, with maps, portraits, and upwards of fifty full-page illustrations by Zwecker and Durand (Macmillan.)

Messrs. Sampson Low, as usual, are to the fore in books of travels. We give the titles and some particulars of seven of them:—*Turkistan*, Notes of a Journey in the Russian Provinces of Central Asia and the Khanates of Bokhara and Kokand, by Eugene Schuyler, Secretary of American Legation, St. Petersburg. This book will be profusely illustrated.—*The Straits of Malacca, Indo-China, and China*, or Ten Years' Travels, Adventures, and Residence Abroad, with upwards of sixty woodcuts from the author's own photographs and sketches, by J. Thompson, F.R.G.S., author of "Illustrations of China and its People." This work contains a narrative of the writer's personal experience and adventures in the Straits of Malacca, Siam, Cambodia, Cochin-china, and China, illustrated with over sixty wood engravings from the author's sketches and photographs. A long residence in the Straits of Malacca enabled the author to visit some of the native states, and to give an account of our important colonial possessions in that quarter of the globe, as also of his personal intercourse with the native Malay rulers, and his estimate of the value of the Chinaman and of Chinese labour in a tropical region.—*The Second North German Polar Expedition in the years* 1869—70, of the ships *Germania* and *Hansa*, under command of Capt. Koldeway, edited and condensed by H. W. Bates, Esq., of the Royal Geographical Society, and translated by Louis Mercier, M.A. (Oxon.) The narrative portion of this important work will be full of interest and adventure in the ice-fields; and, in addition to much matter of great scientific value, will give a graphic account of the hardships and sufferings of the crew of the *Hansa* after the crushing of that ship in the ice.—*Warburton's Journey across Australia*, an account of the Exploring Expedition sent out by Messrs. Elder and Hughes, under the command of Colonel Egerton Warburton, giving a full account of his perilous journey from the centre to Roebourne, Western Australia, with illustrations and a map, edited, with an Introductory Chapter, by H. W. Bates, Esq., of the Royal Geographical Society.—*Captain Tyson's Arctic Adventures*; Arctic Experiences, containing Captain George E. Tyson's Wonderful Drift on the Ice-Floe, a history of the *Polaris* Expedition, the cruise of the *Tigress*, and Rescue of the *Polaris* Survivors, to which is added a General Arctic Chronology, edited by E. Vale Blake, with a map and numerous illustrations.—*The Marvellous Country*, or Three Years in Arizona and New Mexico, by Samuel W. Cozzens, illustrated.—*The Earth as Modified by Human Action*, by George P. Marsh, being a new edition of "Man and Nature."

Mr. Murray announces *Six Months among the Palm Groves, Coral Reefs, and Volcanoes of the Sandwich Islands*, by Isabella Bird, author of "The Englishwoman in America," with illustrations.

Messrs. Trübner have nearly ready *A Peep at Mexico*, Narrative of a Journey across the Republic from the Pacific to the Gulf, in December 1873, and January 1874, by J. L. Geiger, F.R.G.S, with four maps and forty-five original photographs.

In MEDICINE, &c., the announcements are very numerous; we give the more important. Messrs. Longmans have in the press *A Dictionary of Medicine*, edited by Richard Quain, M.D., F.R.S., assisted by numerous eminent writers.

Messrs. Charles Griffin will publish very shortly *Outlines of the Science and Practice of Medicine*, a Handbook for Students, by William Aitken, M.D., F.R.S.

From Messrs. Churchill we receive notice of the following forthcoming books among a long list of others, viz.:—*Air, Water, and Sewage*, a Manual of Analysis for Medical Officers of Health, &c., by Francis Sutton, F.G.S., and William Thorp, B.Sc., F.C.S.—*A Handy-Book of Forensic Medicine and Toxicology*, with numerous wood engravings, by W. Bathurst Woodman, M.D. St. And., Assistant Physician and Lecturer on Physiology at the London Hospital, &c., and C. Meymott Tidy, M.A., M.B., Medical Officer of Health and Food Analyst for Islington.—*Experimental Investigation of the Action of Medicines*, a Handbook of Practical Pharmacology, with engravings, by T. Lauder Brunton, M.D., D.Sc., Lecturer on Materia Medica in the Medical College of St. Bartholomew's Hospital.—*The Diseases of Tropical Climates and their Treatment*, with Hints for the Preservation of Health in the Tropics, by J. A. B. Horton, M.D. Edin., F.R.G.S., Staff-Assistant-Surgeon of the Army Medical Department.—*The Face, Mouth, and Throat*, the Surgical Treatment of their Diseases, Injuries, and Deformities, with engravings on wood, by Francis Mason, F.R.C.S., Senior Assistant Surgeon and Lecturer on Anatomy at St. Thomas's Hospital.—*The Student's Guide to the Diseases of the Eye*, with engravings, by Henry Power, M.B., F.R.C.S., Senior Ophthalmic Surgeon to St. Bartholomew's Hospital.—*Report on the Issue of a Spirit Ration during the March to Coomassie*, by E. A. Parkes, M.D., F.R.S., Member of the General Medical Council.—*The Student's Guide to the Practice of Midwifery*, with engravings, by D. Lloyd Roberts, M.D., Vice-President of the Obstetrical Society of London, Physician to St. Mary's Hospital, Manchester.—*Clinical Studies of Disease in Children*, by Eustace Smith, M.D., F.R.C.P., Physician to the King of the Belgians, Physician to the East London Hospital for Children.

Messrs. Charles Griffin have nearly ready *A Dictionary of Hygiene and Public Health* (with illustrations), comprising Sanitary Chemistry, Engineering, and Legislation, the Dietetic Value of Foods, and the Detection of Adulterations, based on the "Dictionnaire d'Hygiène Publique" of Prof. Ambroise Tardieu, by Alexander Wynter Blyth, M.R.C.S., L.S.A., A.R.C., Medical Officer of Health, and Analyst to the County of Devon.

Messrs. Smith, Elder, and Co. also promise us a work *On the Curative Effects of Baths and Waters*, being a Handbook to the Spas of Europe, by Dr. J. Braun, with a Sketch on the Balneotherapeutic and Climatic Treatment of Pulmonary Consumption, by Dr. L. Rohden, an abridged translation from the third German edition, with Notes, by Hermann Weber, M.D., F.R.C.P., London Physician to the German Hospital.

The following BOTANICAL BOOKS are advertised as coming out this season:—*Medicinal Plants*, by Robert Bentley, F.L.S., Professor of Botany in King's College, London, and Henry Trimen, M.B., F.L.S., of the British Museum, and Lecturer on Botany at St. Mary's Hospital Medical School. This work will include full botanical descriptions and an account of the properties and uses of the principal plants employed in medicine, especial attention being paid to those which are officinal in the British and United States Pharmacopœias. The plants which supply food and substances required by the sick and convalescent will be also included. Each species will be illustrated by a coloured plate drawn from nature. This will be published in monthly parts, and Part I. will be ready very soon (Churchill.)—*Pharmacographia*, a History of the Principal Drugs of Vegetable Origin found in Commerce in Great Britain and British India, by F. A. Flückiger and D. Hanbury, F.R.S. (Macmillan.)—*The Primæval World of Switzerland*, by Prof. Oswald Heer, of the University of Zurich, translated by W. S. Dallas, F.L.S., and edited by James Heywood, M.A, F.R.S., with numerous illustrations. (Longmans.)

In the Sciences of GEOLOGY and MINERALOGY, &c., we are promised *Geology, for Students and General Readers*, embodying the most Recent Theories and Discoveries, by A. H. Green, M.A., Professor of Geology and Mining in the Yorkshire College of Science. Part I. The Elements of Physical Geology, with upwards of 100 illustrations by the author. Part II. The Elements of Stratigraphical Geology, with upwards of 100 illustrations by the author. (Daldy, Isbister, & Co.) The same publishers also have *Geological Climate and Time*, a Theory of Secular Changes of the Earth's Climate, by James Croll, of H.M. Geological Survey; *A Treatise on Mining*, by Lottner and Serlo, of the Berlin Academy of Mining, translated from the German by Prof. Le Neve Foster and Mr. Galloway, with 268 illustrations and diagrams; and *The Creation*, or Dynamical System of the Earth's Formation, in accordance with the Mosaic Record and the latest Discoveries of Science, by Archibald T. Ritchie.—*The Origin of Creation*, or the Science of Matter and Force, a New System of Natural Philosophy, by Thomas Roderick Fraser, M.D., and Andrew Dewar. (Longmans.)—*The Dawn of Life upon the Earth*, by J. W. Dawson, LL.D., F.R.S., F.G.S., Principal and Vice-Chancellor of McGill University, Montreal, with illustrations. (Hodder and Stoughton.)

Finally, among MISCELLANEOUS BOOKS the following will probably interest the majority of our readers:—A new edition is nearly ready of *The Origin of Civilisation and the Primitive Condition of Man*, Mental and Social Condition of Savages, by Sir John Lubbock, Bart., M.P., F.R.S. (Longmans.)—*Outlines of Cosmic Philosophy, based on the Doctrine of Evolution, with Criticisms on the Positive Philosophy*, by John Fiske, M.A., LL.B., formerly Lecturer on Philosophy at Harvard University. (Macmillan.)—*On the Sensations of Tone*, as a Physiological Basis for the Theory of Music, by Prof. H. Helmholtz, translated (with the author's sanction) from the third German edition by Alexander J. Ellis, F.R.S., F.S.A. (Longmans.)—*Out of Doors*, a selection of original articles on Practical Natural History, by the Rev. J. G. Wood, M.A., F.L.S., author of "Homes without Hands," &c., with six illustrations, from original designs engraved on wood by G. Pearson. (Longmans.)—*Insects Abroad*, being a popular account of foreign insects, their structure, habits, and transformations, by the Rev. J. G. Wood, M.A., F.L.S., illustrated with 600 figures by E. A. Smith and J. B. Zwecker. (Longmans.)—*The Aërial World*, by Dr. George Hartwig. (Longmans.)—*Memoir of Sir Roderick Murchison*, including extracts from his journals and letters, with notices of his scientific contemporaries, and a sketch of the rise and progress, for half a century, of Palæozoic Geology in Britain, by Archibald Geikie, LL.D., F.R.S., Murchison Professor of Geology and Mineralogy in the University of Edinburgh, and Director of the Geological Survey of Scotland. (Murray.)—*The Physics and Philosophy of the Senses*, or the Mental and the Physical in their Mutual Relations, by R. S. Wyld, F.R.S.E., illustrated. (King and Co.)—*The Elements of the Psychology of Cognition*, by Robert Jardine, B.D., D.Sc., Principal of the General Assembly College, Calcutta. (Macmillan.)—*On Parasites in the Animal Kingdom*, by M. Van Beneden. (King and Co.)—*The Doctrine of Descent and Darwinism*, by Prof. Oscar Schmidt. (King and Co.)—*Optics*, by Prof. Lommel, profusely illustrated. (King and Co.)—*Fungi*, their Nature, Influences, and Uses, by the Rev. M. J. Berkeley and Dr. M. Cooke, profusely illustrated. (King and Co.)—*Scientific London*, an account of the History and present scope of the principal Scientific Societies and Institutions of London, by Bernard H. Becker. (King and Co.)

THE NEW REPTILE-HOUSE IN THE JARDIN DES PLANTES

THE new house for Reptiles and Batrachians in the Jardin des Plantes at Paris was opened to the public last week. It contains four divisions: two larger central, and two smaller end compartments, all connected by folding doors. The front larger compartment is fitted up in the middle with large shallow tanks for the Crocodilia, of which there are five examples of *Crocodilus vulgaris*, *C. frontatus*, *Alligator mississippiensis*, and two species of *Jacare*. In front is a row of glass cages for Snakes—Boas, Pythons, and various Colubrines. The second larger compartment is devoted chiefly to Batrachians, and contains various Salamanders (*Triton*, &c.), and a large number of Axolotls (*Siredon*). In one tank are the two celebrated specimens of this most abnormal of creatures which have got rid of their external gills and converted themselves into the Salamandroid form, *Amblystoma*. In one of the end compartments are the venomous snakes; in the other, Lacertilia of various kinds.

The cages for the Snakes are fitted up with moss, earth, and stones, which are certainly prettier and more natural than the gravel and blankets used for the same purpose in our Zoological Gardens. But the difficulty seems to be that the animals conceal themselves and are not easily extracted from their hiding-places, whereas a blanket is readily unfolded when the occasion requires, and is more easily kept clean and tidy.

There can be no question of the great improvement of this house as compared with its predecessor, nor of its superiority to the Reptile-house in our Zoological Society's Gardens, so far as concerns space and arrangement. But as regards the extent of the collection, we believe the London Society still holds its own.

NOTES

SEVENTY-FIVE cases of specimens taken by the *Challenger* expedition have been received at the Admiralty from Prof. Wyville Thomson.

THE vessel bearing the French Transit Expedition, under charge of M. Janssen, was caught in the typhoon which swept over Hong Kong on Sept. 23; although the ship appears to have suffered, the *personnel* and apparatus are happily safe. We may state that M. Janssen's wife accompanies him.

FROM the list of the lectures to be delivered during the present term at Oxford, on subjects connected with Natural Science, the want of organisation among the teachers of its different branches is but too apparent. The four biological courses—by Prof. Rolleston (1), Mr. Lankester at Exeter College (2), Mr. Barclay Thompson at Christ Church (3), and Mr. Chapman at Magdalen (4)—are to be on (1) The Comparative Anatomy of Vertebrata, (2) The Structure and Genealogy of Vertebrata, (3) Ichthyic Anatomy, (4) The Anatomy of Vertebrata; so that no provision is made for those who are studying Human Anatomy, nor the Invertebrata. Histology fares hardly any better, for its rapid progress during the last few years has quite overthrown the practical microscopy of ten years ago. The Professor of Experimental Philosophy and Dr. Lee's Reader in Physics are also both to lecture on Electricity.

SIGNOR L. M. D'ALBERTIS, the Italian naturalist, who recently ascended the Arfak Mountains in New Guinea and made so many important discoveries, is now at Genoa preparing for a fresh expedition into the same country, and will leave Europe in about a month's time. On this occasion the traveller will endeavour to penetrate into the southern part of that *terra incognita*, that is into the district adjacent to Torres Straits, where mountain-ranges of considerable altitude are known to exist. Should he succeed in his arduous enterprise, there can be no doubt that he will reap an abundant harvest, as the zoology of this part of New Guinea is absolutely unexplored.

SIGNOR D'ALBERTIS' former companion, the distinguished botanist, Dr. Beccari, is still in the East. His last letters, dated at Macassar in August last, announce his recent return there from an excursion into the south-eastern districts of Celebes. We believe that Dr. Beccari also is preparing for a fresh expedition to New Guinea.

UNDER the sanction of the trustees of the British Museum, the course of twelve lectures on Geology, which the liberal endowment of Dr. Swiney makes *free to the public*, will this year be delivered by Dr. Carpenter, at the Birkbeck Literary and Scientific Institution, Southampton Buildings, Chancery Lane, on Saturday evenings, at half-past seven o'clock, commencing Saturday next. We understand that the main purpose of the course will be to elucidate the past history of the earth by the study of the changes at present in progress; and that the course will include an account of the lecturer's own researches in the deep sea. It will be illustrated by an extensive series of photographs and paintings, exhibited by the oxy-hydrogen lantern.

THE South African correspondent who sent us the Natural History Notes which appeared in NATURE, vol. x. p. 486, is Mr. J. P. Mansell Weale.

IT has been decided to publish, as a yearly volume, a Record of Works on Geology, Mineralogy, and Palæontology, British and Foreign. The first volume will be printed by the middle of 1875, and will contain short abstracts or notices of papers, books, maps, &c., published during the year 1874. It is estimated that this volume will contain from 200 to 300 pages, and that its price will be 10*s*. 6*d*. The gentlemen named below have volunteered to assist in the work, which has already been begun. Those marked * have taken charge of various sections (as sub-editors), and the last has undertaken the post of general editor:—* W. Carruthers, F.R.S. (British Museum); C. E. De Rance, F.G.S. (Geological Survey); R. Etheridge, jun., F.G.S. (Geological Survey of Scotland); D. Forbes, F.R.S.; Prof. Geikie, F.R.S. (director of the Geological Survey of Scotland); * Prof. A. H. Green, F.G.S.; Prof. T. R. Jones, F.R.S.; A. J. Jukes-Browne, F.G.S. (Geological Survey); * G. A. Lebour, F.G.S.; * L. C. Miall (Leeds Museum); E. T. Newton, F.G.S. (Jermyn Street Museum); Dr. H. A. Nicholson, F.G.S.; * F. W. Rudler, F.G.S. (Jermyn Street Museum); E. B. Tawney, F.G.S. (Bristol Museum); * W. Topley, F.G.S. (Geological Survey); Henry Woodward, F.R.S. (British Museum); H. B. Woodward, F.G.S. (Geological Survey); W. Whitaker, F.G.S. (Geological Survey). The work will be greatly helped if Provincial Societies and Field Clubs will forward copies of their publications to the editor. It is hoped, from the low price, that the number of subscribers will be enough to cover the expenses of printing; but should this not be the case, a number of eminent scientific gentlemen have kindly consented to act as guarantors. Names of intending subscribers, and of societies and institutions that will purchase the Record for 1874, will be gladly received by the editor.

MR. WILLIAM DITTMAR, F.R.S.E., Lecturer on Chemistry at Owens College, Manchester, has been appointed Professor of Chemistry at Anderson's University, Glasgow, in the place of Dr. Thorpe, who has been elected Professor of Chemistry at the Yorkshire College of Science.

DR. WILLIAM STIRLING has been appointed assistant to Dr. Rutherford, the newly elected Professor of Physiology in the University of Edinburgh.

DR. JAMES APJOHN has resigned his appointment of Professor of Chemistry in the Medical School of Trinity College, Dublin.

MR. BRYCE M. WRIGHT, the well-known collector of fossils, who for some time past had been far from well, died last week.

A NEW wing has been quite recently added to King's College, London, by means of which considerable improvements have been made in the Physiological Laboratory and the Dissecting Room.

TWO scholarships in Science, of the value of 100*l*. each, have this year been awarded at St. Bartholomew's Hospital; one to Mr. Coates, of Balliol College, Oxford, the other to Mr. Saunders, of Downing College, Cambridge, these gentlemen having been coupled as of equal merit for the first place in the competition.

THE following gentlemen have been elected to the vacant Natural Science Postmasterships in Merton College:—Mr. J. Larden, of Rugby School, and Mr. A. Macdonell, of Aberdeen University. The Delegates of Unattached Students of Oxford University give notice that the Master and Court of Assistants of the Clothworkers' Company have offered three exhibitions of 50*l.* a year each, tenable for three years, for the encouragement of the study of natural science; the first examination to be held at the beginning of the Hilary Term 1875, at which time one exhibition will be awarded. Gentlemen who shall have matriculated in the present term, or who have not yet matriculated, are eligible for this exhibition.

THE following sonnet on the late Dr. Jeffries Wyman appears in the New York *Nation*, with the initials "J. R. L.":—

"The wisest man could ask no more of Fate
Than to be simple, modest, manly, true,
Safe from the Many, honoured by the Few;
Nothing to court in World, or Church, or State,
But inwardly in secret to be great;
To feel mysterious Nature ever new,
To touch, if not to grasp, her endless clew,
And learn by each discovery how to wait;
To widen knowledge and escape the praise;
Wisely to teach, because more wise to learn;
To toil for Science, not to draw men's gaze,
But for her lore of self-denial stern;
That such a man could spring from our decays
Fans the soul's nobler faith until it burn."

A TELEGRAM from Berlin states that Major von Mechow will shortly start by sailing vessel from Rotterdam to succeed Dr. Lohde, who is in ill health, in the military command of the scientific expedition which left Europe in June 1873, under the leadership of Dr. Gussfeldt, for the exploration of Central Africa. The Berlin African Society will also send out a second expedition under the leadership of Captain von Homeyer, which will leave at the end of December. It will first proceed to Canandge, on the frontier of Angola, and will endeavour to reach the capital of Muata-Jamvo.

THE Austro-Hungarian explorers of the North Pole are preparing a popular edition of their adventures, as well as a scientific narrative.

WE learn from *Iron* that a scheme has been recently devised for supplying London with an inflammable mixture of gases to replace coal. The new gas, termed "pyrogen," consists of a mixture of nitrogen and carbonic oxide, three-fourths by weight consisting of the latter gas. The temperature of combustion of the mixture is stated to be 2,700° C.; and for heating purposes the flame of the burning gas is to be allowed to raise some good radiating substance to incandescence in an ordinary grate. It is justly pointed out that with our present arrangements three-fifths of the available heat of coal are wasted, but, on the other hand, it must not be forgotten that on the proposed plan the force evolved in the oxidation of the carbon (in whatever form it is made use of) to carbonic oxide is likewise wasted. We should prefer, on the whole, to see some feasible plan for utilising the waste heat of coal, as the highly poisonous nature of carbonic oxide would, in the absence of all other objections, be a serious obstacle to its introduction into our dwelling-houses.

AT an influential meeting held at Manchester on Monday, to take measures to secure some permanent memorial of the late Sir William Fairbairn, it was resolved to raise funds for the purpose by public subscription, and "that the permanent memorial of Sir William Fairbairn be in the form of a statue of such a character and to be placed in such a position as may be hereafter determined, and also for a scholarship or some other suitable endowment inconnection with the Owens College." It was understood that the scholarship or endowment should have special reference to the teaching of engineering or pure mechanics.

MR. JOHN HORNE, of the Botanic Garden, Mauritius, who is now on a botanical expedition in the Seychelles, writing to Dr. Hooker, says that he has visited the islands of Silhouette, Praslin, and Félicité, searching them from the sea-shore to the tops of the highest hills, in Silhouette up to 2,200 ft., at which elevation Pitcher-plants abound, hanging in immense clusters over every stone, bush, and tree. Flowers of these Nepenthes were obtained, and arrangements made for procuring a good supply of plants. When these materials come to hand it will be seen whether the Nepenthes of Silhouette is different from the *N. wardii* which grows in Mahè. The tops of these mountains where the Pitchers grow have a perpetual moisture hanging over them, being almost constantly enveloped by mist and rain.

WE have received an excellent little Italian work—price only two francs, notwithstanding its many illustrations. It is entitled "Parasiti Interni degli Animali Domestici," and is a translation of the well-known little English work on the subject, by Dr. Spencer Cobbold, F.R.S. The Italians are very anxious to make themselves acquainted with English scientific works, and this translation by Dr. Tommasi, as well as the admirable translation of Huxley's "Vertebrate Anatomy" by Prof. Giglioli, show their earnestness.

THE fifth volume of the "Annali del Museo Civico di Storia Naturale" of Genoa, just issued, is occupied with an excellent memoir on the Ornithology of Borneo, prepared by Count Tommaso Salvadori, of Turin. The memoir is based on the collections made in Sarawak in 1865 and subsequent years, by the Marquis Giacamo Doria and Dr. Odoardo Beccari, which contained about 800 specimens. All previous authorities on the birds of Borneo have been consulted, and the result is a complete *résumé* of all that is yet known upon the ornithology of this most interesting country, which will be highly acceptable to naturalists.

AT two o'clock P.M. on the 18th inst. a severe shock of earthquake was felt at Malta. There was a heaving motion, accompanied by an explosive noise resembling the bursting of a shell. Eight slight shocks followed later. Several buildings are injured, but no casualties are reported.

A TELEGRAM, dated Bombay, Oct. 17, states that a cyclone in Bengal has caused a total interruption of telegraphic communication with Calcutta. Fifty miles of the line are reported to have been blown down, and a passenger train has been thrown off the rails. No further details of the damage done have yet been received.

THE Council of the Labour Representation League have drawn up a Report founded upon the resolutions adopted by the members at a meeting held some weeks since touching the endowed schools in their relation to technical education. The Report, which deals very fully with the question, and which will shortly be published *in extenso*, recommends a scheme of technical training under four heads, viz.—1. In our elementary board schools. 2. The secondary industrial schools. 3. The higher endowed schools, such as Eton, Harrow, &c. 4. The Science and Art Department at South Kensington. The scheme will be submitted to a general meeting of workmen and others interested in the question, for discussion and approval. The Council of the League express themselves very sanguine as to the beneficial results that would follow the adoption of the scheme. In connection with the subject of technical education we may state that the opening meeting of the members of the Artisans' Institute was held on the 14th inst., in the premises of the institution, Castle Street, St. Martin's Lane. The meeting was addressed by the Rev. H. Solly, Mr. Samuel Morley, M.P., Dr. Carpenter, and others, and the promoters are sanguine of its success in educating and elevating skilled workmen.

ON Monday evening a public meeting was held in the hall of Clanricarde College, Pembridge Square, Bayswater, Dr. J. H. Gladstone, F.R.S., presiding, to establish a popular society in

West London for the advancement of natural history and physical science. There was a very good attendance, chiefly of members of the various London field clubs. A number of ladies have been received as members, and working men are represented on the committee.

ACCORDING to the *Belgique Horticole*, Dr. Candèzi has invented a small photographic apparatus, which he calls a "scenograph," which consists simply of a stick and of a camera the size of an opera glass. To photograph a plant or other object, it is sufficient to place it in the focus of the scenograph for a minute or two. The negatives, it appears, can be purchased ready prepared.

THE opening of the School of Horticulture at Versailles, which was to have taken place on Oct. 1, is postponed till Dec. 1.

DR. A. CORLIEU states, in *La France Médicale* for Sept. 30, that he had occasion to search the registers of the parish of Saint Antoine, preserved in the National Library. It was in the cemetery of the Innocents, in that parish, that the dead bodies from the Hôtel-Dieu were interred; and Dr. Corlieu has ascertained that during the first six months of 1694 the deaths in the hospital amounted to 11,696. In 1873, during the same space of time, the mortality amounted to 770 for 925 beds.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*) from South Africa, presented by Mr. J. D. Lloyd; a Ducorps' Cockatoo (*Cacatua ducorpsi*) from the Solomon Islands, presented by Mr. F. J. Dean; two Lions (*Felis leo*) from South Africa; a Malbrouck Monkey (*Cercophithecus cynosurus*) from West Africa; a Sun Bittern (*Eurypyga helias*) from South America, deposited; two European Rollers (*Coracias garrula*), European; a Naked-throated Bell-bird (*Chasmorhynchus nudicollis*) from Bahia; a solitary Tinamou (*Tinamus solitarius*) from Rio de Janeiro, purchased.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopic Science* for this month commences with two articles which are of special interest to embryologists, and therefore to biologists generally. The former of these is by Mr. F. M. Balfour, entitled "A Preliminary Account of the Development of the Elasmobranch Fishes;" it occupies about forty pages, and is fully illustrated. The investigations were conducted at the Zoological Station at Naples, which illustrates the value of that institution, and the justifiableness of Dr. Dohrn's enthusiasm. The earliest stages of development are those most minutely described. The points of greatest interest made out are the following:—(1) The epiblast of the blastoderm in that part which corresponds to the caudal extremity of the future embryo, folds round inwards and becomes continuous with the deeper layers; which leads the author to conclude that, as the hypoblastic origin of the alimentary canal is connected with the presence of a food-yolk, and in origin its those animals which develop an "anus of Rusconi" is not so, the former is but an adaptation. (2) The notochord is shown to be developed from the hypoblast, the mesoblast forming a mass on each side of it. This may depend upon the mesoblast, whose lateral columns just referred to, are "split off, so to speak, from the hypoblast," also developing a median independent sheet; or it may be, which unbiassed observation undoubtedly supports, that the notochord is a true hypoblastic structure. The former of these views, as the author remarks, "proves too much," since it is clear that by the same method of reasoning we could prove the mesoblastic origin of any organ derived from the hypoblast and budded off into the mesoblast. If Mr. Balfour's fundamental fact is verified, it will much modify the argument as to the homology of organs as based upon their embryonic origin. (3) The medullary groove is quite flattened out in the cephalic region at the time that the canal is fully formed in the caudal. This paper is well worthy of careful study.—Mr. Ray Lankester writes on the development of the pond snail (*Lymnæus stagnalis*), and on the early stages of other mollusca. He begins by describing the shell-gland, which is situated below the developing shell; he shows its presence in Lamellibranchs, Gasteropods, Pteropods, also in the Brachiopoda and *Loxosoma*. From this the question is asked whether it in any way corresponds to the pen of the Dibranchiate Cephalopoda and the internal shell of *Limax*. Reasons are given in favour of the plug, which is always found to occupy the shell-gland, being developed into the latter; but with regard to the former, the author, from originally holding the opinion that it has a similar origin, now thinks differently for the following reasons:—The pen of *Loligo* must correspond to the guard of the Belemnite, in which the phragmacone is aborted. This guard is only a sheath to the phragmacone, which again corresponds to the whole shell of *Spirula*. The shell of *Spirula* must have been preceded by the shell-gland, therefore the plug of the latter cannot have been the direct origin of the *Loligo* pen. The latter part of the paper discusses the development of the pond-snail in detail.—Mr. E. A. Schäfer describes an ingenious and much-improved microscope warm-stage, in which a mercury valve regulates the gas supply to a small circulating boiler. He remarks that much of the cooling is produced by the proximity of the objective, and suggests that this may be warmed by coiling a tube round it. It has always occurred to us to ask whether the heating of objectives does not injure, for the time being, their optical powers; as they are constructed so as to be achromatic, &c., at the average temperature of the air, and very slight differences must produce material changes in the distance between the lenses and their shape.

Bulletins de la Société d'Anthropologie de Paris, fascicule v. tome 8, 1874.—M. Topinard concludes his paper on the anthropology of Algiers, by drawing attention to the five periods which characterise the anthropological history of the colony, and which are those of the brown-skinned Kabyles; the light-skinned Kabyles; the Numidians, to whom we must refer the greater number of the Berber inscriptions hitherto found; the Romans, Arabs, and Turks; and lastly, the Aryans. M. Topinard is of opinion that in the fair and dark skinned Berbers we have a kindred race with our oldest West-European races, and that therefore, with due regard to locality, we have evidence that European colonies could be made, like those tribes, to flourish in various parts of Algiers. In the meanwhile, however, as General Faidherbe has remarked, it becomes a question of political as well as ethnological importance to investigate and, if possible, arrest the causes which are diminishing the numbers of the native population, whose existence is the more important from their being the best able to bear the climate and cultivate the soil. M. Topinard considers that the mortality among the native races is not to be referred with any special prominence to diseases introduced by Europeans, but is due very much more to a natural scrofulous diathesis antecedent among them, to any imported constitutional taint, while famine, war, and many other causes depending upon political conditions are probably the most important agents in the process.—M. de Mortillet has recalled the attention of the Society to M. l'Abbé Bourgeois' assumed evidence of the existence of man at the base of the Miocene or mean Tertiary, while he presented to them one of the latest of the Abbé's finds of flint implements from the Miocene beds at Thenay, and which in its longitudinal lines showed unmistakable traces of cutting. The speaker pointed out that since the foundation of the calcareous beds at Beauce, and the deposit of the flints at Thenay, the mammalian fauna has been renewed at least three times, while the differences between the extinct and living fauna are sufficient to justify the acceptance of the supervention of specific genera. The question of the existence of man in the mean Tertiary period rests, however, for the present, open, and must await further discoveries of a less questionable nature before it can obtain an unassailable solution.—M. Onimus, in a paper on language, has considered at length the importance of reflex action generally on all phenomena of the nervous system and on the intellectual functions, illustrating his point by reference to the changes in the faculty of speech which give rise to aphasia, and considering the manner in which the latter lesion is modified by the previous and normal mental condition of the patient. This number also contains a suggestive paper, by Madame C. Royer, on the mathematical laws of reversion through atavism; notes by M. Bataillard on the Gipsies of Algiers; and a report of the hairy dog-man of Kostroma, in whom an abnormal development of the hair of the head and the down on the face and neck, combined with considerable prognathism, has similated the characters of the canine head.

The *Bulletin de la Société d'Acclimatation de Paris* for July devotes a considerable portion of its space to the description of an ostrich farm at the Cape of Good Hope. This industry is largely extending in that colony, and yields excellent results.—M. Maumenet gives a valuable contribution in the shape of a paper on the various plants acclimatised by him at Nîmes, in the province of the Gard. Bamboos, Eucalyptus, palms, and several new and useful Chinese plants and vegetables, are among his successful attempts at acclimatisation.—M. Martinet gives details of the mode of cultivating the *Erythroxylon coca* in Peru, a vegetable which the French are desirous of introducing into Algeria and French Guiana.—M. Collenot suggests, as a means of staying the ravages of the Phylloxera, that instead of introducing American vines, the wild vines abundant in many parts of France should be carefully cultivated; they produce, in a wild state, excellent fruit, and as they are very hardy, he thinks that they would withstand the attacks of this pest.—A Japanese tree, the Sophora (*Styphnolobium japonicum*), is recommended for cultivation as rivalling the Eucalyptus in many respects. The wood is very hard, and a tree planted in France thirty-five years ago is now 21 ft. in circumference. It resists cold and drought with equal facility.—The silkworm is being acclimatised in the Baltic provinces, and some species of this caterpillar seem able to withstand the cold with ease.

SOCIETIES AND ACADEMIES

LONDON

Royal Microscopical Society, Oct. 7.—Charles Brooke, F.R.S., president, in the chair.—A paper, by Mr. Alfred Sanders, entitled "Supplementary Remarks on the Appendicularia," was read to the meeting by the secretary, in which the author corrected several observations made in the course of a previous paper, and gave an exhaustive description of a species which he believed to be different from any hitherto described, although he refrained at present from naming it as new.—A paper by Mr. Kitton, of Norwich, was also read by the secretary, upon some new species of diatoms found in deposits sent from New Zealand by Mr. H. R. Webb and by Capt. Perry from Colon.—Mr. Slack made some observations on silica films prepared from a solution containing four parts glycerine to one part water, and pointed out the difficulty of obtaining clear definition of the forms presented when high-power objectives of large angle were employed, whereas those with small angular aperture gave good results.—Mr. Stewart drew the attention of the Fellows to a remarkable living organism exhibited in the room by Mr. J. Badcock, of the nature of which very considerable doubt was entertained, the prevailing opinion being that it was either an entozoon or the larval form of some unrecognised animal.

LEEDS

Naturalists' Field Club and Scientific Association, Oct. 13.—Mr. Edwd. Thompson, vice-president, in the chair.—A lecture was delivered by Mr. Samuel Jefferson, F.C.S., upon "Volcanic Phenomena." After giving the more familiar facts with regard to the shape and formation of volcanic cones, the nature of the ejected materials, the periods and frequency of eruptions, and the distribution of volcanic energy, and after an exposition of the chief hypotheses which have been framed with regard to the internal condition of our earth, Mr. Jefferson pointed out a coincidence which had not to his knowledge been previously noticed, that the equatorial diameter between the two centres of intensity of volcanic energy, Java and Quito, is shorter by two miles than that drawn at right angles through Africa. Mr. Jefferson explained his views at some length.

PHILADELPHIA

Academy of Natural Sciences, June 2.—Dr. Ruschenberger, president, in the chair.—"Poisonous character of the flowers of *Wistaria sinensis*."—Mr. Meehan remarked that there was a popular belief that the flowers of the *Wistaria sinensis* were destructive to bees. He had himself seen hundreds of dead bees under large flowering plants. He was struck with the fact this season that none were dead under similar circumstances. The flowers were continually visited by the honey bee and others, without, so far as he could see, any fatal results following. It was clear, therefore, that whatever might be the cause of the death of these insects under some circumstances, it could not be from the honey alone.—"Growth of the *Cuicus arvensis*, Hoff." In regard to the rapidity with which plants sometimes grew, Mr. Thomas Meehan observed that, though it was well known that the Canada thistle spread surprisingly, there had been no figures giving its exact growth placed on record. From experiments he found that it spread at an average rate of about three-fourths of an inch of growth per day, equal to maize or other rapid-growing vegetation above ground.

June 16.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy made remarks on the revivification of *Rotifer vulgaris*, showing that when the animals are actually dried they are incapable of being revivified.—Prof. Cope mentioned the capture of a young *Balæna cisarctica*, of forty-eight feet in length, in the Raritan River, near South Amboy. He was informed that the whale was entirely black, and the dorsal line without irregularities.—Prof. Cope explained the distinctive features of the genus Symborodon, one of the gigantic horned mammalia of Colorado, as compared with Titanotherium, exhibiting typical specimens of the latter from the Academy's museum, showing four inferior incisor teeth, while the lower jaw of Symborodon does not possess any.

PARIS

Academy of Sciences, Oct. 12.—M. Bertrand in the chair.—The following papers were read:—The enunciation of the principle of the theory of *timbre* is due to Monge, by M. H. Resal.—Letter from M. Langley, director of the Alleghany Observatory, United States, on cyclonic movements, by M. Faye. This paper was an extension of the author's theory of sun-spots. The laws of fluids in rotatory motion round a vertical axis are shown to apply to these phenomena.—M. Daubrée made some remarks in connection with the foregoing paper concerning the indications of circular motion traced in the diluvian deposits of the neighbourhood of Paris.—Critical observations on the employment of the tincture or powder of guiacum for testing the purity of "*kirschenwasser*," by M. Boussingault.—M. C. Sédillot communicated a surgical paper on the subject of preventive trepanning.—Presence of the genus Lepisosteus among the fossils of the Paris basin, by M. P. Gervais.—External linear extraction, simple and combined, of cataract; a surgical memoir, by M. R. Castorani.—Proportion of real to sulphated ashes in the products of the sugar industry, by M. Ch. Violette.—Communications relating to the destruction of Phylloxera were received from MM. Maurice Girard, Mouillefert, Balbiani, &c., upon which remarks were offered by M. Dumas.—New experiments with alkaline sulphocarbonates for the destruction of Phylloxera; method of employing them, by M. Mouillefert.—Researches on the action of coal-tar in the treatment of phylloxerised vines, by M. Balbiani.—On the employment of electro-diapasons of variable periods as tonometers and electric contact breakers, by M. E. Mercadier.—Attempted theory of the formation of the secondary facets of crystals, by M. Lecoq de Boisbaudran.—Microscopic study and proximate analysis of a pumice from Vesuvius, by M. F. Fouqué. Under the microscope this stone was seen to be composed of a multitude of crystals of amphigene united by an amorphous vitreous substance; of crystals of hornblende, pyroxene, peridote, oxide of iron, feldspath, and brown mica irregularly distributed through the mass. An analysis of the amphigenetic crystals proved this mineral to be rich in sodium and calcium; the amphigene from the tufa of Somma is generally potassic.

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DIARY OF SOCIETIES.

LONDON

THURSDAY, OCTOBER 22.

JUNIOR PHILOSOPHICAL SOCIETY, at 7.30.—Principles of Art: J. R. Hilder.

FRIDAY, OCTOBER 23.

QUEKETT MICROSCOPICAL CLUB, at 8.—On cutting Sections of the Eyes of Insects, and on a New Instrument for that purpose: R. P. Williams.

LEEDS

TUESDAY, OCTOBER 27.

NATURALISTS' FIELD CLUB AND SCIENTIFIC ASSOCIATION, at 8.—Solar Physics: John Garbutt, F.R.A.S.

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THURSDAY, OCTOBER 29, 1874

METEOROLOGY IN FRANCE

WE hail with much satisfaction the movement which has just been made by the French Government in the direction of a more effective organisation than has hitherto existed for the investigation of the meteorology of France. The best results may be expected from the step just taken, which is detailed in the printed documents quoted below,* and when we consider the great contributions made to practical meteorology by Le Verrier, the distinguished head of the Paris Observatory, in the *Bulletin International,* the *Atlas des Mouvements Généraux de l'Atmosphère*, and the *Atlas des Orages* originated under his direction, we may rest assured that these hopes will be fully realised.

In the decree of February 13, 1873, in which the basis of the reorganisation relative to the meteorology of France was laid down, occurred the following resolutions :—

"1. The investigation of the great movements of the atmosphere and meteorological warnings for the seaports and for agriculture are remitted to the Observatory of Paris.

"2. The working out of the meteorology of the various river-basins of France, and cognate inquiries, is handed over to Commissions representing the different regions and departments of the country, the organising of which the Council of the Observatory is commissioned to prosecute."

In carrying out these resolutions, the meteorological warnings to the seaports were re-established by the Observatory on May 17 of the same year. The duty of issuing meteorological announcements to all departments for the benefit of agriculture, especially in time of harvest, was recognised, and it was at the same time suggested that an inquiry be set on foot with the view of organising a system by which this could be effectually done.

As regards the second resolution, a systematic inquiry into the climate of France had been organised in 1865 by the appointment of Departmental Commissions, and the establishment of a system of observations chiefly by the primary normal schools. At first, when the Departmental Commissions were yet imperfectly organised, it was found necessary to concentrate the observations made over the country in the Observatory of Paris, which undertook their discussion and publication ; but this system, which was forced on the Observatory at the time, could not be indefinitely continued with advantage. The grounds for this opinion are stated in these words :—

"From 1869 the Observatory continued to point out that the discussion of the climatic conditions of the different river-basins of France could not be concentrated in Paris with advantage. It seemed necessary that the large body of skilled meteorologists that had been formed during the four years which had elapsed should boldly take the observations into their own hands, in order to discuss them and deduce from them the scientific truths they may be shown to teach. It was not merely from the advantages which would accrue to meteorology itself by adopting this line of action that the effort towards decentralisation was put forth, but from the intimate bearing which the partition of the work of meteorological inquiry over the whole breadth of the country had on the scientific movement of France, in favouring the spirit of original inquiry and research without which no nation can take a high position in science."

The circumstances which followed hindered the carrying out of these proposals. Subsequently, however, the matter has been resumed and dealt with successfully in several parts of the country, particularly in the basin of the Meuse and over the western sea-board of the Mediterranean, by concerted action on the part of the five departments of Hérault, Gard, Aude, Pyrénées-Orientales, and Lozère. The Astronomical Commission nominated for the purpose of proposing the best measures to be taken in reorganising the astronomical department entered into the same view, and recommended further that inquiries referring to the climate of France be remitted to Regional Committees appointed by departments grouped together according to the river-basins.

"But it must be observed that the proposed institution of Regional Committees will in no way interfere with the Departmental Organisation, but is intended, on the contrary, to give greater weight and vigour to the operations of the Departmental Commissions, in that united action in certain lines of inquiry is thereby facilitated ; it being evident that the area embraced by a single department is too small for the proper study of many of the widespread meteorological phenomena which pass across it. The local Commissions have repeatedly drawn attention to this great disadvantage ; the organisation by regions will, however, henceforth give to the departments the means of publishing the results of their inquiries in a more complete form. In correcting the system of centralisation which had been carried to so great an excess, it is not intended to leave the Commissions to themselves, with no connecting link between them and the Central Administration. On the contrary, the Observatory of Paris is specially instructed to be in active and fruitful correspondence with the Departmental Commissions, and to give assistance, as far as the Commissions may desire, in organising them by regions."

The programme, thus briefly sketched, has been only imperfectly followed out, solely on account of the pecuniary difficulties. But these difficulties the National Assembly has now removed by authorising the necessary funds. What then is now required, and what is now asked by the Minister of Public Instruction, is that the Prefects enter in the departmental budgets such a sum as may in each case be required by the Commission, and we are glad to learn that there is no doubt that the request will be generally acceded to. M. de Cumont concludes his letter with the remark : "I shall act in concert with my colleague, the Minister of the Interior, in carrying out the propositions of the decree of Feb. 13, 1873, to secure the regular despatch of the meteorological warnings to those departments whose scientific Commissions are put in possession of the requisite funds to enable them to take advantage of the warnings in the interest of agriculture."

In the meantime, the Observatory has hastened the resumption of the publication of the "Atlas Météorologiques de la France," which has been stopped for some years. To make up for lost time, the first issue, which is ready for delivery, embraces the three years 1869, 1870, and 1871, and consists of four parts, viz. :—

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* "Letter from M. A. de Cumont, Minister of Public Instruction to the Préfets of the Departments, Paris, October 9, 1874." "Letter from M. Le Verrier, Director of the Paris Observatory, to the Presidents of the Meteorological Commissions of the Departments, Paris, October 9, 1874."

(1) Discussion of the thunderstorms (*orages*) of these years, illustrated with forty-six maps. (2) Hailstorms, with three maps. This part of the work, which is of so much importance to agriculture, has been unfortunately neglected for some time, but is now to be vigorously prosecuted. (3) Report on the climatic observations made in France, and particularly on the distribution of rain, with four maps. (4) Meteorological memoirs and documents (thirteen in all), contributed by different meteorologists of France and other countries, a section of the work which is expected to receive a fuller development in future issues.*

A noteworthy feature of the publication consists in the fact that the materials which make it up have been collected under the auspices of the Departmental Commissions, and in great part discussed by them. This is, particularly for such a country as France, an admirable arrangement, since there is no European country the working out of the meteorology of which presents a more complex problem, owing to the great diversity of the climates of its different regions; and further, the agricultural interests of no other country would benefit more than those of France, were a correct knowledge of its climate generally disseminated among the people. Now, this feature of the publication gives the local colouring to the reports which is fitted to arrest general attention and secure the putting forth of those local efforts by which alone the meteorology of France can be satisfactorily worked out.

It may be here pointed out that the French meteorological organisation is based on the Commissions which have been appointed in each of the departments; it being to them that the Government, in the decree of Feb. 13, 1873, has remitted the working out of the meteorology of the different river-basins, and inquiries connected therewith. They are invited to unite together for certain objects into Regional Commissions, for the purpose of imparting to their investigations greater breadth and exactness. They are not put under the Central Administration at Paris in the sense of being controlled by it, but are connected with it in order that they may be aided by it in cases where aid is needed. The Departmental Commissions have free automatic action in working out the problem of the local climates of the respective districts which have been entrusted to them.

The programme assigned to the Central Observatory of Paris, consisting of the investigation of the great movements of the atmosphere, and meteorological warnings for the seaports and for agriculture, is too limited in its scope; and we cannot suppose that its illustrious head will be satisfied till he has succeeded in including in the regular work of the Observatory those physical researches we have already strongly advocated in NATURE (vol. x. p. 99) as an indispensable part of the work to be undertaken by the Central Meteorological Office of each country, and which have been more recently and ably stated by Prof. Balfour Stewart and Col. Strange (pp. 476 and 490).

In the same article we urged the necessity of the State and the country working together; indeed, in no other way is it possible successfully to work out the great national questions of storms and of local climates in their bearings on the health, productions, and commerce of the country. In France we see that this essential requisite, of the State and the country working together, has been effected, and it may not be irrelevant to add that the French Government has clearly recognised the position that unaided voluntary efforts are insufficient of themselves to cope with the subject, and that if the undertaking is to be conducted in a manner worthy of the nation and of the ends to be subserved by it, it must be supported with aid from the public funds.

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*MAREY'S "ANIMAL MECHANISM"**

Animal Mechanism. By E. J. Marey. "The International Scientific Series." (London: Henry S. King and Co., 1874.)

II.

In his treatment of aërial locomotion, Prof. Marey has been even more successful than in his investigations with regard to progression on land. Nearly two centuries ago the general principles of this subject were very ably worked out by Borelli, who, after having shown that in the wing the anterior margin is rigid whilst the posterior portions are more and more flexible as they go backwards, inferred, as will be self-evident to all, that in the downward stroke of the flying bird the plane of the wing becomes directed downwards and backwards on account of the hinder margin yielding slightly to the resisting air. It not having struck him that the wing was elastic in its horizontal as well as its vertical direction, Borelli assumed that the stroke was strictly vertical.

By a series of experiments, the logical sequence and convincing power of which are perhaps unequalled in any other extant biological problem, Prof. Marey has been able to demonstrate the effects of the horizontal yieldingness of the wing, and to prove that in insects the stroke, instead of being, as Borelli assumed, a simple vertical line, is a vertical figure of 8. In proof of this original and, at first sight, unexpected observation, he shows that if the tip of the wing of a wasp be gilt, and the insect allowed to buzz in a beam of sunlight, a very elongated vertical figure of 8 image is seen, as in Fig. 1, to be produced by the reflecting tip of the rapidly moving wing; "sometimes, indeed, the wing seems to move entirely in one plane, and the instant afterwards the terminal loops which form the 8 are seen to open more and more. When the opening is very large, one of the loops usually predominates over the other; it is generally the lower one which increases, while the upper diminishes. Indeed, by a still greater opening, the figure is occasionally transformed into an irregular ellipse, at the extremity of which we can recognise a vestige of the second loop."

There is still more to be learnt from this simple experiment. By carefully gilding one surface of the wing alone, the buzzing wing, when intensely illuminated, exhibits the figure of 8 of unequal intensity in its two moieties, as seen in Fig. 1; so that it resembles the figure printed thus, **8**, if its thick part be considered to represent that which is most illuminated, and its thin part the darker half. This result can only be produced by the plane of the wing being different in the up and down strokes; and, as is found to be the case, the thick limb is reversed by turning the insect round so that it presents its other side to the observer. The same conclusion is arrived at by the employment of the method to be now described.

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* The price of the volume, post-free to England, is, we understand, 10s. (12 fr.)

* Continued from p. 500.

Without sensibly interfering with the movement of the wing, its tip may be made to come in contact with a revolving cylinder, in which the surface is covered with smoked paper. "Although the figures thus produced are for the most part incomplete, we are able, by means of their scattered elements, to reconstruct the figure which has been shown by the optical method." Fig. 2 is one of the results obtained, in which several of the loops are distinctly seen, as is generally the case when, as here, the insect is so held as to rub the cylinder with the hinder edge of the tip of the wing. That a figure of 8 movement of a point, when made to record on a revolving drum, produces a similar curve, is seen from Fig. 3, which is a tracing of a Wheatstone's kaleidophone rod, tuned to the octave, or, in other words, vibrating twice transversely for each longitudinal vibration.

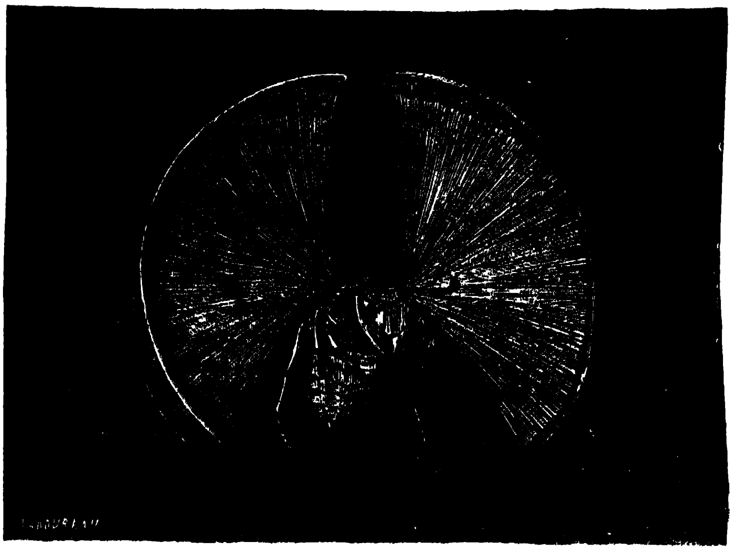

FIG. 1.

Still we are not able to say in which direction the wing is moving in the different branches of the 8 figure; the following simple experiment determines this completely.

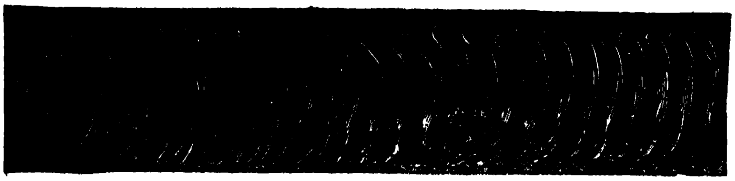

FIG. 2.

A slender glass rod is smoked at the tip in the flame of a candle, and held at right angles to the direction in which the wing moves, in the different parts of the wing-tip tract, as in Fig. 4. It is evident that if the wing hits the rod whilst it is descending, it will rub off the smoke film from its upper, and whilst ascending, from its lower surface. Supposing that, in the figure, the head of the insect is directed to the right: when the glass rod enters the loops at *b′* and *a* it is found to strike the upper surface; when at *b* and *a′*, the lower; consequently the arrows indicate the true direction of the wing's motion.

FIG. 3.

The foregoing facts, when taken in connection with their known anatomical arrangements, place us in a position to discuss the mechanism of the flight of insects. These animals possess muscles, &c., which produce direct downward and upward movements of the wings, and these movements only; therefore the expansion of this vertical line into a figure of 8 must be caused by forces acting external to the thoracic or wing-moving mechanism; in other words, by peculiarities in the structure of the wings themselves. Simple inspection of the wing of a fly shows it to be formed of a rigid, or comparatively rigid, anterior nervure, which supports a thin more yielding membrane behind it. In its descent, the resistance of the air retards the movement of the more yielding posterior portion of the wing sufficiently to cause the lower surface of its otherwise horizontal plane to become directed slightly backwards, and in its ascent the same cause directs it somewhat forward. But an inclined plane striking the air has a tendency to move in the direction of its own inclination; consequently, both in the down and up stroke of the wing, it tends to move forward at the same time. "But this deviation cannot be effected without the nervure being slightly bent. The force which causes the wing to deviate in a forward direction necessarily varies in intensity according to the rapidity with which the organ is depressed. Thus, when the wing towards the end of its descending course moves more slowly, we shall see the nervure, as it is bent with less force, bring the wing backwards in a curvilinear direction. Thus we explain naturally the formation of the descending branch of the 8 passed through by the wing;" and the same theory applies to the ascending branch of the figure.

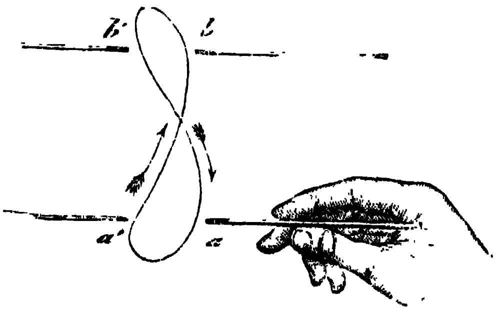

FIG. 4.

Acting upon the suggestions of his theory, Prof. Marey has constructed artificial wings, which are planned and move upon the same principle as those of insects. He has not succeeded in making a flying machine, it is true; this, however, is not from any fault in the wings, but because it is impossible to obtain an engine sufficiently light to drive them. He has, however, contrived an apparatus which, when the motor power is supported, is capable of moving horizontally with rapidity, of rising and of falling, just like an insect; and, what is more, when propelled by a simple up and down movement, the tips of the wings describe a figure of 8 of their own accord, as they ought to do upon the theory which led to their construction.

The mechanism of the flight of birds is a problem far more difficult to master than that of insects. The size of the subjects of experiment, and the comparative slowness of the movements of their wings, remove them beyond the reach of the optical and direct graphic method previously employed. Each stroke of the wing has to be recorded through the intervention of a complicated system of tubes and levers, as fragile as they are delicate, and as expensive, as they are liable to be broken. Movements in a single plane are capable of being transferred to paper with comparative ease, but when they are not so limited, and may be in any direction, the necessary complication of the recording machinery becomes immense. The number of little details which have to be continually remembered, and the oft-repeated futile attempts which have to be allowed for, makes Prof. Marey's success in his investigations a matter of more than ordinary surprise. He has mastered the whole subject, having by separate and by combined check methods demonstrated what is the rapidity, direction, and inclination of the wing of the bird in every part of its course. Further than this, he has shown what effects the stroke has on the movements of the body of the bird, and this by a very ingenious new method. The way in which the author invents means for reproducing and originating any quality of movement he may want to develop, must be a source of admiration and almost astonishment to all readers of his work.

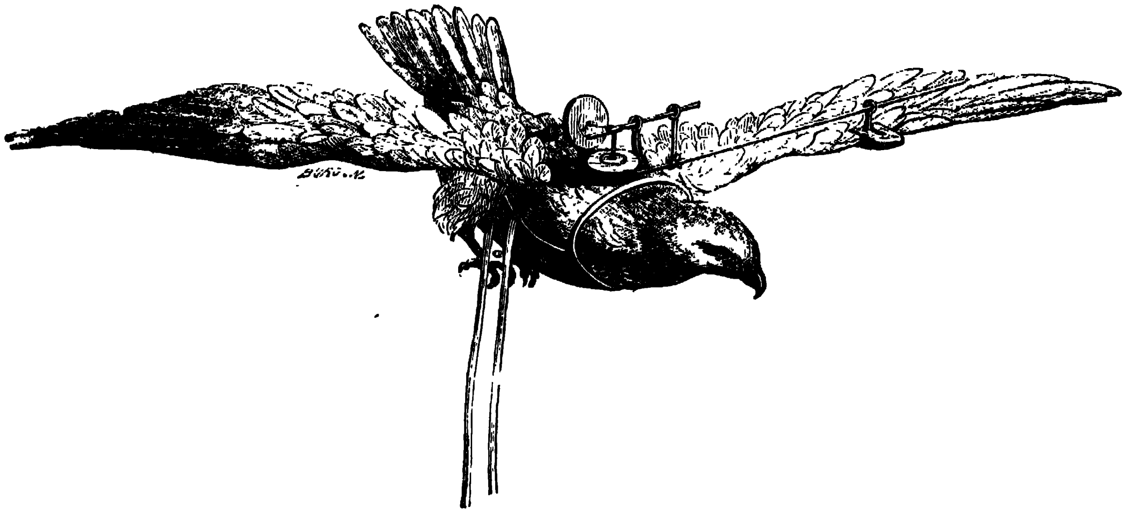

FIG. 5.

Fig. 5 shows a buzzard saddled with the machinery which, by means of the two tubes running downwards from it, transmits the vertical and horizontal movements of its wing to the recording apparatus, which is not represented. In the study of the more intricate points the necessary instruments are so heavy that the whole bird has to be partially supported. This is done by attaching it to the extremity of a long lever which revolves, with scarcely any friction, on a pivot. This is found not seriously to interfere with the normal flight of the bird.

Most of the facts made out by the employment of this apparatus are shown in Fig. 6, which is constructed to illustrate the inclination of the plane of the wing with reference to the axis (*Av*) of the body of the bird during flight. The direction of the movement of the wing is from *H* to *Av*. It shows "that the wing during its ascent assumes an inclined position, which allows it to cut the air so as to meet with the minimum of resistance; while in its descent, on the contrary, the position of its plane is reversed, so that its lower surface turns downwards and slightly backwards." During the descent of the wing the body of the bird is carried forwards as well as upwards. The resistance of the air explains the elliptical form of the figure.

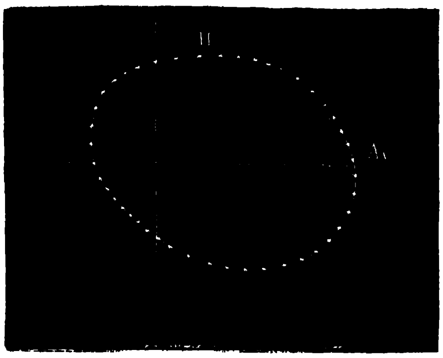
FIG. 6.

We hope that in the short glance which we have taken of some of the most important points discussed in the work before us, we have succeeded in interesting our readers sufficiently in its contents to make them curious to learn more of its subject matter. We cordially recommend it to their attention. To the student of art it gives rules and general principles which will be found invaluable in all attempts to portray the various attitudes of man and his faithful companion, the horse; and these, when understood, will direct attention to the most salient points in the locomotion of other animals.

To the student of physiology it is useful in at least two ways. It shows how invaluable is a knowledge of manipulatory details and the principles of mechanics. Prof. Marey, in the period of his studentship, must have learnt more than the simple routine facts of a medical education. The mechanical Cardan universal joint and Wheatstone's kaleidophone rod are as familiar to him as is the valvular mechanism of the heart; it is his control of method which is one of his most marked characteristics. It shows how elaborate are some of the phenomena which at first sight seem so simple, and how much the science of physiology is within the domain of physics.

The translation, as far as we have had the opportunity of judging, seems a good one, except in one or two cases, where improvement would not be impossible.

OUR BOOK SHELF

The Protoplasmic Theory of Life. By John Drysdale, M.D. (Baillière, Tyndall, and Cox, 1874.)

THE author of this small book is one of the editors of a work on Pathology, by Dr. John Fletcher, of Edinburgh, whose "Rudiments of Physiology" contains much speculative biology of no mean quality. As a disciple he enters into an analysis of the philosophy of his master, discussing its details in connection with the light thrown upon it by modern research, especially the bioplasm theory of Beale. Fletcher argued thus:—The peculiar property, vitality, does not reside in the tissues of the living body indiscriminately, but in one anatomical element alone; because, as the various tissues differ extremely in their physical properties, and these latter are almost exactly the same after as before death, it is hardly to be expected that the living matter can rearrange itself on death, in a short time, into a number of different forms, which shall possess exactly the same physical properties in the vital as in the ordinary state of combination. The concordance of this idea with the theory of Dr. Beale, which divides all tissues into a living forming material (bioplasm), and a dead formed material, the composition of the latter of which alone varies to any extent, must be evident to all; and the working out of its minutiæ occupies several chapters of the work before us. The author also enters fully into the muscle and nerve theory of Dr. Beale in a manner which we do not think will throw much light on either subject. He remarks that the insulating power of the medullary sheath of the nerve-fibre is not demonstrable, therefore "the nerves are not fitted for simple conduction of electric currents; and these have no reason to choose the nerves as their channels, so they spread through the moist tissues almost uniformly." With this opinion we think there are few or no physiologists who will agree, as there is not the least doubt that it is through nerve-fibres that electric stimulation will most readily and most powerfully affect muscular fibres at a distance; otherwise, what is the peculiar value of the "nerve-muscle preparation" of the physiological laboratory? In his remark that Dr. Sanderson is premature in arguing with regard to the Dionæa "that because the contraction of the plant-leaf depends on changes, apparently in the contents of the cells, the muscular contraction of the higher animals is of the same nature," the author is, we think, more fortunate; we have never been able to see that the two phenomena have anything in common. From the consideration of the less speculative protoplasmic theory of the origin of tissues, such points as the nature of life, the connection of force with life and mind, consciousness, and materialism, subjects beyond the pale of precise knowledge, are treated of in a manner which will quite repay perusal by those who are fond of speculating on those precarious topics.

Out of Doors: a Selection of Original Articles on Practical Natural History. By the Rev. J. G. Wood, M.A., F.L.S. (London: Longmans and Co., 1874.)

MR. WOOD is well known as one of the most successful popularisers of natural history. He has himself an extensive and thorough knowledge of his subject, as well as a genuine love of it, and his genial enthusiasm cannot fail to infect the minds of the fortunate boys and girls into whose hands his books may fall. The present volume consists of a number of thoroughly readable papers which have already appeared in various periodicals. They are written in an easy, graceful, chatty style; and while apparently trying only to amuse his readers, he manages to convey a great deal of valuable information about animals and plants, especially about such as anyone who likes to take the trouble may observe for himself. Some of the papers are concerned with exotic animals, as in that describing "A January Day at Regent's Park," in which are contained many facts concerning the inhabitants of the Zoological Gardens. Most of them are, however, about the "common objects of the country," as is indicated by such titles as "A Sand Quarry in Winter," "Under the Bark," "My Toads," "The Children of the New Forest," "The Repose of Nature," the last concerned with hybernating animals. In "Medusa and her Locks," and "Life on the Ocean Wave" (describing a visit to the Crystal Palace Aquarium), "The Green Crab," &c., we are introduced to the denizens of the ocean. The book is an excellent one to give to a boy or a girl, who, we are sure, would enjoy it, as indeed would many whose boyhood or girlhood is only a sad memory.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

Automatism of Animals and Men

I WAS surprised to see by Mr. Wallace's letter of last week that he and I had understood Prof. Huxley's address in senses entirely different. I understood Prof. Huxley to mean that not only the reflex action of animals, but also all the conscious, so-called voluntary actions of men—those, for example, that we perform for the first time and, as we say, with a conscious end in view—are purely automatic; that is, that consciousness, while it accompanies the workings of the animal machine, never stands in a causal relation to any movement whatever; that no movement ever was the result of a state of consciousness, that every movement is the result of physical antecedents which, being present, the movement must of necessity follow, and that in this physical chain there is no break whatever. Years ago I saw no escape from this conclusion, and I have repeatedly made explicit statements of it in the pages of this journal and elsewhere. I was therefore gratified to find Prof. Huxley agreeing with the doctrine; and that the British public should be so little startled by his announcement of an opinion which has seemed absurd to almost everyone to whom I have attempted to expound it, struck me as rather curious. But the explanation is easy, if a man of such fine and cultured intellect as Mr. Wallace could so completely miss the meaning of Prof. Huxley's discourse.

DOUGLAS A. SPALDING

The Edible Frog

YOUR correspondent Mr. Miller (vol. x. p. 483), will find, in Cooke's "British Reptiles," p. 103, accounts of other endeavours to naturalise *Rana esculenta*. About ten years ago I imported a basket full from the Parisian fish-market, where they can easily be obtained, and turned them out into a pond at Woburn Abbey, in Bedfordshire. They thrived and multiplied there; but our summers are seldom hot enough to enable the tadpole to attain his full development before the cold autumnal nights set in. Last week, for example, I forwarded to Prof. Huxley a living tadpole of *R. esculenta*, born in Bedfordshire, who will scarcely complete his evolution before the winter, though his hind legs are fully developed. I have several summers, however, observed a plentiful supply of young *esculentæ*, and I believe that in our climate the young will pass the winter as tadpoles, and complete their transformation in the following spring. But this would require more accurate observation before I can affirm it with certainty. During the past summer I imported from Berlin a fresh supply of 200 exceedingly fine specimens, as my French frogs had been reduced in numbers after the frequent visits of a heron. *R. esculenta* is easily imported in the spring, and will travel many days packed in damp moss. These frogs are easily preserved, being more aquatic in their habits than our *R. temporariæ*, who roam through the woods and meadows in search of food when the breeding season is over, while the edible frog remains on the banks of his native pond, into which he plunges, describing a graceful curve, at the slightest approach of danger. They have been introduced into Ireland quite lately, from France, by the Earl of Granard, at Castle Forbes; with what success I am unable yet to say. In the spring any number can be easily obtained from the Parisian market, or the aquarium shop of M. Carbonier, 20, Quai du Louvre, Paris; or from the keeper of the reptiles in the Jardin des Plantes, who always has a plentiful supply to feed his snakes.

The laboratories of our lecturers on physiology are supplied from Leipzig, annually, with living *R. esculentæ*, and Mr. Miller can easily obtain the address of the dealers who export them.

Oct. 26 ARTHUR RUSSELL

Colour in Flowers not due to Insects

FROM Mr. F. T. Mott's letter, in your last issue (p. 503), I can hardly imagine him to be acquainted with the literature of the subject on which he writes. The difficulties he suggests, though great, are, I think, not unanswerable.

1. Cultivation seldom greatly affects the size or colour of the first cultivated individual. In the cases in which it does so, Mr. Darwin considers the origin of the variation to be due, as suggested by Knight, to change, or excess in food ("Origin of Species," chap. i.) Where the variation is at first slight and slowly intensified, this is the result of artificial selection.

2. When we consider the exhausting character of the reproductive process, we may perhaps think that the abortion of the sexual organs by the multiplication of phyllæ is the result of weakness; but a high state of cultivation, or any excess of food, predisposes to the degradation of organs, the excessive growth of parenchyma, rapid growth, and disease. Organs are also absorbed by heat or by frost. As to the perpetuation of such forms, Mr. Darwin instances ("Origin of Species," chap. viii.) some varieties of the annual stock which produce both double sterile and single fertile seedlings, justly comparable to the fertile and neuter forms of social insects.

3. The "abortive flowers" of such umbellate and capitulate inflorescences as the Guelder Rose, Hydrangea, and Centaurea, where not effected by artificial selection, act as a lure to the central fertile florets, as shown by Dr. Ogle (*Popular Science Review*, April 1870), originated according to the law of balance of growth.

4. The beauty of fruits "serves merely as a guide to birds and beasts, in order that the fruit may be devoured and the manured seeds disseminated" ("Origin of Species," chap. vi.)

5. "We meet very commonly with gaily-coloured chemical products, essentially connected with the normal processes of development, and originating from venomous infection by insects, or from decomposition. These colours appear to be merely an accidental quality of the chemical products . . . natural selection is without any influence as to colours, unless animals are attracted or repelled by them" (Hermann Müller: NATURE, vol. ix., p. 460). Mimicry has been recorded in fungi (NATURE, vol. vii. p. 55). Mr. Mott's letter indicates the fallacious opinions that mere beauty or variety are objects in nature, and that the Darwinian hypothesis deals with the origin of variations.

G. S. BOULGER

Harrow Road, W., Oct. 26

ABLER pens than mine will probably reply to Mr. Mott's letter in NATURE, vol. x. p. 503; but if not, may I be permitted to point out that the facts therein adduced, as not harmonising with the theory that colour in flowers has been assumed for the purpose of attracting insects, are capable of explanation.

1. *Cultivated flowers.*—The greater size and brilliancy of colour attained by these is not due to cultivation alone, but to selection practised by the cultivator. He chooses his seeds from the plants that bear the largest and best coloured flowers, and thus, directly and intentionally, performs the very work that in a state of nature is carried out, indirectly and unconsciously, by the insect fertiliser.

2. *Double flowers* are only accidental, and not permanent, in a state of nature. The cultivator has succeeded in producing and preserving them by giving a preference to, and propagating from, those plants which bear flowers with a tendency to become double. Here also intentional selection by the gardener has taken the place of natural selection by the insect.

3. The *abortive flowers* of the Guelder Rose and Hydrangea, as they grow naturally, are confined to the outer part of the corymbs, and serve the same purpose as the ray of Compositæ (which in some species consists of neuter florets) and the highly coloured floral bracts of some plants, viz., to attract insects to the fertile flowers they surround. The garden forms of Viburnum and Hydrangea, the corymbs of which are composed entirely or nearly so of sterile flowers, are, like double flowers, the result of intentional selection by the cultivator.

4. The brilliant colours of many succulent fruits have resulted from their superior attractiveness, not indeed to insects for the purpose of fertilisation, but to birds and other fruit-eating animals for the purpose of dissemination, as has been well described by Prof. Hildebrand. The occurrence of brilliant colours in the vegetable kingdom, independently of the agency of insects, as on fruits, galls, fungi, and lichens, is no more irreconcileable with the theory that the colour of *flowers* has been brought about by that agency, than is the occurrence of bright colours on insects themselves and other members of the animal kingdom, or the vivid colour of many mineral substances.

Newton-le-Willows, Oct. 26 THOMAS COMBER

Migration of Birds

I HAVE waited for some time to see if anyone would ask Prof. Newton or Mr. Tegetmeier, on what evidence the latter gentleman has been led to "declare that knowledge of landmarks obtained by sight, and sight only, is the sense which directs these birds," viz., carrier-pigeons. (See NATURE, vol. x. p. 416.) As no one has asked this question, I am obliged to do so myself; but at the same time I should like to say that it is only because the subject is one of great importance that I think we should not here be satisfied with an authoritative statement of opinion, without some indication of the kind and degree of evidence on which such opinion is based. Moreover, it seems to me particularly desirable, that if a man of Mr. Tegetmeier's immense experience in this matter has any conclusive reasons for his decision, the public should have the benefit of their recital; so that the vexed question as to the "homing" of pigeons may once for all be settled.

The importance of settling this question I deem almost impossible to overrate; for, with all deference to Prof. Newton, I do not see why "sight alone cannot be regarded as of much aid to birds which at one stretch transport themselves across the breadth of Europe," if it is once satisfactorily proved that "sight, and sight alone, is the sense which directs" carrier-pigeons, say, from Paris to London. For it must be remembered that carrier-pigeons are descended from a non-migratory species of bird, and may therefore well be supposed not to have the faculty of remembering landmarks so fully developed as is the case in migratory species, where this faculty has doubtless been deeply impressed by means of natural selection. Further, we must not forget that in the case of all migratory birds, the younger generations fly in company with the older ones; so that the former must make several journeys before it devolves upon them to lead the way.

When the instinct question was last discussed in NATURE, I published a summary of the evidence which had been adduced by the correspondence. As at that time I thought with Prof. Newton that the supposition of sight being the faculty to which the return of carriers is due was a very improbable one, I argued that to account for the facts of migration by a similar supposition would be unwarranted. But when so great an authority has found cause to alter his opinion regarding the supposition on which my previous argument was founded, I think the fact bids fair, not only to destroy that argument, but, as just shown, to reverse it. Now I call attention to this in order to show how much depends upon a final determination of the instinct question so far as carrier-pigeons are concerned. In no other case of "homing" (and migration is nothing more) are we able to subject the birds to experiment; so that if this has been done in the case of pigeons with unequivocally positive results, we are at any rate in possession of a valid analogy from which to establish a probability as to the nature of the migratory instinct in general. And the value of this probability would be more definite if Mr. Tegetmeier would tell us what he thinks, or knows, to be the utmost limit of a pigeon's memory for landmarks.

GEORGE J. ROMANES

The Aboriginal "Murri" Race of Australia

(Communicated by Sir J. Lubbock, F.R.S.)

HAVING lately had an opportunity of reading your work on "The Origin of Civilisation," it has occurred to me that some information which has come to my knowledge during missionary tours among the aborigines known as the race of Murri, and during a journey afterwards undertaken at the instance of the Government of this Colony to the Namoi and Barwun Rivers, may be acceptable to you. Through Prof. Max-Müller my journal and my grammar of "Kamilaroi, Dippil, and Turrubul" were transmitted to the Anthropological Society; and I suppose all I have written is accessible for the purposes of philosophical investigation among the records of that society. I now confine my statements to points touched upon in those parts of "The Origin of Civilisation" which treat of the Australian aborigines.

Page 11. In the north-western part of this colony, about the tributaries of the Darling, a man will not look at his mother-in-law. If they meet accidentally they turn back to back, and take no further notice one of another.

P. 34. My experience differs entirely from that of Mr. Oldfield. Having shown many drawings and paintings of animals and men—including their own likenesses—to the aborigines, I always found them quick at perceiving the design. They themselves trace on the trees, with their tomahawks, fair representations of snakes and other animals.

P. 109. It is true no man may marry a woman of the same names as his sisters. But it is by no means true, as Dr. Long stated, on imperfect information, that no one can marry a woman "of the same clan," taking the word "clan" in the common sense of the term as equivalent to "gens." The rule that restricts marriage is founded on an exact law of pedigree and class names. It is as follows among the aborigines of the Namoi; and other tribes have rules similar in the main, though the names differ widely.

The men are all divided into four classes—Murrī, Kumbo, Ippai, and Kubbi. The Murrī (whose name differs from that designating the race, "Murrĭ," only in the quantity of the last syllable) are regarded as the most important; the Kubbi are the lowest in esteem. The sisters of these four are respectively Mātā (or Matha), Būtha, Ippatā, and Kubbotha (the vowels are pronounced as in French). So that in one family every son bears the name Murrī, every daughter the name Mata; in another family every son is Kumbo, every daughter Butha. There is also another classification marked by "totems," in which a second name is given to everyone according to birth. Thus there are the *bundar* (kangaroo), *meité* (opossum), *dūlī* (iguana), *nūrai* (black snake), *dīnoūn* (emu), and others. On these classifications are based laws of marriage and descent. A Murri may marry Butha of the same totem, and of any other totem he may take a Mata, though she bears the name of his own sisters, who are all Mata. So Ippai dīnoūn may marry Ippata nurai, but not Ippata dīnoūn. But Ippai dīnoūn may marry Kubbotha dīnoūn.

Children always bear the second name (or totem) of their mother; and the first name of the child depends on the mother's. Thus the sons and daughters of Mata are always Kubbi and Kubbotha; those of Butha are Ippai and Ippatha; those of Ippatha are Kumbo and Butha; those of Kubbotha are Murri and Mata. As Ippai generally marries Butha, Ippai's son is generally Murri, but not always. When Ippai's wife is other than Kubbotha, his son is other than Murri. At first it seemed to me that the father's name determined that of the son; but afterwards I found that it is by the mother's name that those of the children are fixed. It is remarkable that while the second name of a child is the same as the mother's, the first, though dependent on the mother's, is always different. Mata's daughter cannot be a Mata, but is always Kubbotha. The Rev. Lorimer Fison, who had been in communication with Prof. Goldwin Smith and others on the "Tamil" system, and had found that system in Fiji, on seeing the rules of marriage and descent which I had noted down as prevailing among the Kamilaroi of Australia, said the principles of the "Tamil" were observed here also.

They have no words meaning simply brother and sister, but use terms signifying elder brother and younger brother. Thus "daiadī" is elder brother, "gullami" younger brother; and in a family of six brothers the eldest has no daiadī, but five gullami; the youngest has no gullami, but five daiadī; the third has two daiadī and three gullami. "Boādi" is elder sister, "burandi" younger sister. "Gunī" (γυνή) is the child's word for "mother dear."

P. 205. The Kamilaroi and Wiradhuri tribes, who formerly occupied a large territory on the Darling and its tributaries, have a traditional faith in "Baiame" or "Baiamai," literally "the Maker," from *baia*, to make or build. They say that Baiame made everything. Some say that he once lived as a man upon earth; and near the Narran River is a hole in a rock, somewhat in the shape of a man, where they say Baiame used to rest. He makes the grass to grow, and provides all creatures with food. Baiame gave them a sacred wand, which they exhibited at their "bora," the initiatory rite of admission to manhood, and the sight of this wand is essential to make a man. Baiame once showed the black fellows how to get rid of "Mullion," a demon in the form of an eagle, who lived in a tree and devoured many people. Baiame is also the Supreme Judge who awards to men their future lot. When people die, the good ascend to Baiame, and he appoints them a place on the great *warrambool* (watercourse, with groves, fruits, and animals, for the enjoyment of the blessed), in the sky—the Milky Way; the bad perish at death.

The Rev. James Gunther, of Mudgee, who was many years engaged in the instruction of the Wiradhuri tribes, has recorded the fact that these people ascribe to Baiame "three of the attributes of the God of the Bible"—supreme power, immortality, and goodness. There are among them men who make light of these traditions; but even when first spoken with by Christian instructors, some were evidently devout in their thoughts of Baiame and their hopes of a future life; and as to a future state, they generally have a lively expectation. A squatter, M. De Becker, who lived many years at a remote station, where the blacks were in frequent communication with him, told me he had seen many of them die with a cheerful anticipation of being soon in a "better country." WILLIAM RIDLEY

Paddington, Sydney, Australia, July 11

Reported Discovery of Gold in Samoa

FROM a note in NATURE (vol. ix. p. 273) I am surprised to learn that Mr. Williams, H.M.'s Consul in these islands, has stated, in an official despatch to the Foreign Secretary, that gold in quartz has been found on Upolu, in a valley about three miles from the Port of Apia. The samples assayed are said to have yielded at the rate of 3,000 ozs. to the ton.

No geologist who knows Samoa will believe that gold in paying quantities has been found in this island. Still, I think it right to give the following explanation of what gave rise to the above report.

A few months ago gold was said to have been found, as reported by Mr. Williams. Most people here, however, disbelieved it, thinking the report had been raised by unprincipled men for the purpose of attracting settlers and promoting the sale of land. Some believed the pretended specimens of Samoan gold had not been found in Samoa, and felt quite certain they had not been procured in the particular valley specified.

The facts of the case have been lately disclosed, since Mr. Williams left the islands in ill health; he was therefore in ignorance of them when he wrote his despatch from Sydney in October 1873.

The specimens of gold assayed were brought from the Thames gold diggings in New Zealand, and two or three foreign settlers here, who own land in the valley where the gold is said to have been found, raised the report in order to sell their land at a high price. They appear to have imposed upon the credulity of the Consul, who took the specimens to Sydney and had them assayed there. S. J. WHITMEE

Upolu, Samoa, June 2

Photographic Irradiation

I SHALL be obliged if you will allow me space to state more specifically why I am not able to concur in the irradiation theory of Mr. Aitken (vol. x. p. 439). I understand from his last letter that he fully agrees with Lord Lindsay and myself as to the cause of the outer irradiation, and our only difference of opinion now lies in the amount of the inner irradiation that can be traced as due to what he has termed *molecular reflection* within the thickness of the collodion film. Mr. Aitken and Capt. Abney both appear to consider this as the chief cause of the inner irradiation fringe, while I am disposed to rank the irradiation arising from the optical imperfections of the instrument with which the photograph is taken; together with any irradiation that may arise in the wet plate processes from circulation in the film of fluid covering the plate—before—or as very much greater in amount than the irradiation due to dispersion within the collodion film.

We should expect that light dispersed within the thickness of the collodion film would produce its photographic effect in all directions round the illuminated point—and that the area of action would not be affected, or certainly would not be decreased, by covering the front surface of the portions of the collodion film adjacent to the directly illuminated area with an opaque object. Indeed, if the opaque object were a good reflector, such as a bright piece of platinum foil, we might expect slightly to increase the area of photographic action due to dispersion within the film; for the light dispersed towards the front surface of the film would be in great measure reflected back into the thickness of the collodion. But, as I have shown in former letters, placing a piece of platinum foil in immediate contact with the collodion film causes the photographic image of a bright image to be sharply cut off, and no perceptible irradiation can be traced under the edge of the foil.

Again, we should expect the action of dispersed light to extend further within a thick film of collodion than within a thin film; for there would be a greater thickness of illuminated collodion, and the angle through which light could be radiated directly upon the adjacent area without suffering reflection at either surface would be increased, but I have not been able to detect any perceptible difference in the amount of irradiation of similarly exposed plates coated with four thicknesses of collodion and in those coated with but one film.

I have felt myself therefore driven to look for the cause of irradiation either in some circulation taking place within the film of liquid covering the collodion at the time of exposure, which film would be interrupted and its tension greatly altered by the contact of a solid body; or else to seek its explanation in the optical imperfections of the photographic instrument. Possibly, in the wet-plate processes, circulation within the fluid film may produce a very sensible effect. Indeed, there are phenomena which make this more than probable. When a wet-plate picture of a strong light projected upon a dark background is taken with a decided over-exposure of say ten minutes or a quarter of an hour, the inner irradiation fringe is seen to be most opaque on its outer edge; and the phenomenon is so marked that it cannot be held to be an effect of contrast. This, of course, should not be the case if the irradiation edge were due merely to the optical imperfections of the instrument. Again, in the small negatives of the eclipse of December 1871, taken at Dodabetta and Baikul, there is a decided structure in the irradiation under the prominences: under the brightest of them it can be distinctly seen that the opacity of the irradiation fringe is greatest along lines radiating from the prominences—while along the outside, that is, furthest from the prominences, there is an arc of slightly greater intensity. The same structure is traceable in all the negatives, but it is most marked in the Baikul series, and especially in those negatives in which the prominences are most exposed, viz., on the east and west limbs, at the beginning and at the end of totality. This, of course, cannot be accounted for merely by the optical imperfection theory. Again, the little brushes mentioned in a former letter as extending under the edge of the platinum foil, cannot be accounted for without supposing that there is circulation within the liquid film. I hope on my return to England to carry out some further experiments for determining the amount of the inner irradiation which in the wet-plate processes may be due to such circulation. A. COWPER RANYARD

Florence

Curious Rainbow

THE unusual phenomena described by Mr. Swettenham as having been observed by him in a rainbow in the Kyles of Bute (NATURE, vol. x. p. 398), are due, I think, to interference. If I remember rightly, he will find an explanation of the matter in "Deschanel's Natural Philosophy," by Prof. Everett.

Clifton, Bristol, Oct. 19 G. J. THOMSON

Aurora

A BRIGHT display of aurora was seen here on Friday, Oct. 16, between eight and eleven o'clock. At ten o'clock, when I first saw it, the arch of the aurora stretched from Pollux to Arcturus, then both near the horizon, the apex of the arch being under Ursa Major. Deep fringes of light hung from the inner side of the arch and moved with a curtain-like motion to the north. The light was white. On Saturday night numerous streamers were seen darting upwards from the horizon; and many falling stars, two of them leaving trains of light for about a second. JAMES S. ANDERSON

Castletown, Caithness, N.B.

Sneezing in Animals

I HAVE a rough-coated terrier dog which will sneeze when told to do so. I taught him this trick by repeatedly imitating sneezing in his presence.

When about to perform, he shakes his head obliquely once or twice, just as many people do, and then ends with a good sharp sneeze. J. F. M. H. S.

THE RECENT ERUPTION OF ETNA

PROF. ORAZIO SILVESTRI has published* his observations on the eruption of Etna which occurred on the 29th of August, and reminds us that two months previously he predicted not only the formation of the fissure on the Mongibello side, but likewise the eruption by which it was accompanied.

After an uninterrupted period of eruptive phenomena by which the central crater was considerably modified, at

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* "Notizie sulla eruzione dell' Etna del 29 Agosto 1874." Catania, 1874.

4 A.M. August 29, subterranean rumblings were followed by two shocks, when a formidable column of black smoke and flaming materials rushed up into the air, and, carried by the wind, fell at great distances, in the form of small scoriæ and sand. Numerous other columns succeeded, with roaring, rumbling noises, lasting for seven hours with great intensity, dying away towards night. The noises ceased on the 30th of August, and vapour and smoke alone rose from the crater and along the line of disturbance.

When the volcanic tremors were most intense, at 4 A.M. 29th August, a fissure appeared on the north side of the great central crater, extending for five kilometers, with an axis running E. by 8° N. The centre of the impellant force was at an elevation of 2,450 metres, between two mountains of lava known as *Fratella Pii* and *Monte Grigio*, where the rent widened to its maximum width of fifty to sixty metres, whence it narrows very steadily towards the base, terminating after a course of three kilometres. And at this altitude, where the greatest thrust was manifested, may be noticed the formation of a new mountain, or crater, with an elliptical contour, coinciding with the fissure in the direction of the axis. It has a diameter of about 100 metres, and covers a superficial area of about 117,734 square metres. This crater, now appearing as a new mountain, is formed of doleritic lava and a pre-historic grey Labradorite, torn from the surface by the black lava of this eruption, in which they are enveloped. There are thus mingled two lavas of the most distant epochs in the history of Etna, the older forming the framework of the mountain. The crater shows internally the usual funnel shape; and near its base, over a width of fifty to sixty metres, there are ten eruptive mouths, open wide, which succeed each other like button-holes;—those nearest the crater are abysses twenty-five to thirty metres in diameter along the line of the fissure. There are also two other groups of small cones, in which the diameter of the mouths is not more than from one to three metres—eight in the second group, and four in the third; so that within a distance of half a kilometre from the crater there are twenty-two minor cones in linear extension. The crack is now continued down a declivity formed by the lava current of 1614, which slopes to the north at an angle of 13° or 14°. Although the rent traverses this lava, there are no more small cones for a distance of 600 metres, when a fourth group of five mouths, each two to three metres wide, is found at an altitude of 2,170 metres; these latter have poured out a torrent of lava descending in a stream 150 metres long, 60 metres wide, and two metres thick. A little lower, at a height of 2,150 metres, is a fifth group of three mouths, more active than the others, but situated like the last group on the great lava stream of 1614. The torrent of lava hurled from these mouths is 400 metres long, 80 wide, and two metres thick, and forms two short bifurcations. Finally, near the end of the crack, at an altitude of 2,030 metres, a sixth and last group of five mouths is formed, which have ejected large quantities of cinder and scoriæ. They are situated about twelve kilometres from the old crater of Mojo, towards which this great crack runs down the side of Etna from its central crater. Besides this principal rent there are an infinite number of smaller clefts, breaking up the soil and radiating from the centres, of great dynamic activity. In a few hours the new mountain and its system of about thirty-five subordinate cones were thrown up, and thus there was brought to the surface a total quantity of about 1,351,000 cubic metres of volcanic materials.

The mingling of the old and new lavas will form the subject of a subsequent memoir. The recent lava, like all modern lavas, is augitic, black, magnetic, and has a metallic lustre. Its specific gravity is 2·3636 at a temperature of 25° Cent. The superficial temperature of the lava was 70°, while at a depth of half a metre it was 90°, and a still higher temperature was recorded where fumeroles were active.

From the remarkably short duration of the eruption, Prof. Silvestri anticipates a more powerful outburst to come, which will be manifested along the rent in making which the present internal explosion has spent its force.

Concurrently with this disturbance the whole of volcanic Italy has been affected. The island of Volcano, after a century of quiescence, discharged cinders and flaming materials from its vast crater for nine months previous to the eruptive phenomena of Etna in the autumn of 1873. The eruption of Volcano continued decreasing in intensity through July 1874, and traces of it are still continually seen. Stromboli last June made a rare eruption, sending out small stones with great energy in place of its characteristic feeble incessant explosions.

Vesuvius has not been unsympathetic, and discharged an unusual volume of dense vapour at the end of August contemporaneously with the eruption of Etna.

THE SECOND AUSTRO-HUNGARIAN EXPEDITION TO THE NORTH POLE, UNDER WEYPRECHT AND PAYER, 1872—74.

ON the return of the Austrian North Polar Expedition we gave in NATURE, vol. x. p. 439, an outline of the discoveries made. From the original memoirs on the achievements of the voyage, by Dr. A. Petermann, Dr. Joseph Chavanne, and Dr. v. Littrow, which have been kindly forwarded to us by the first-named, along with the map, we are able to give still further details.

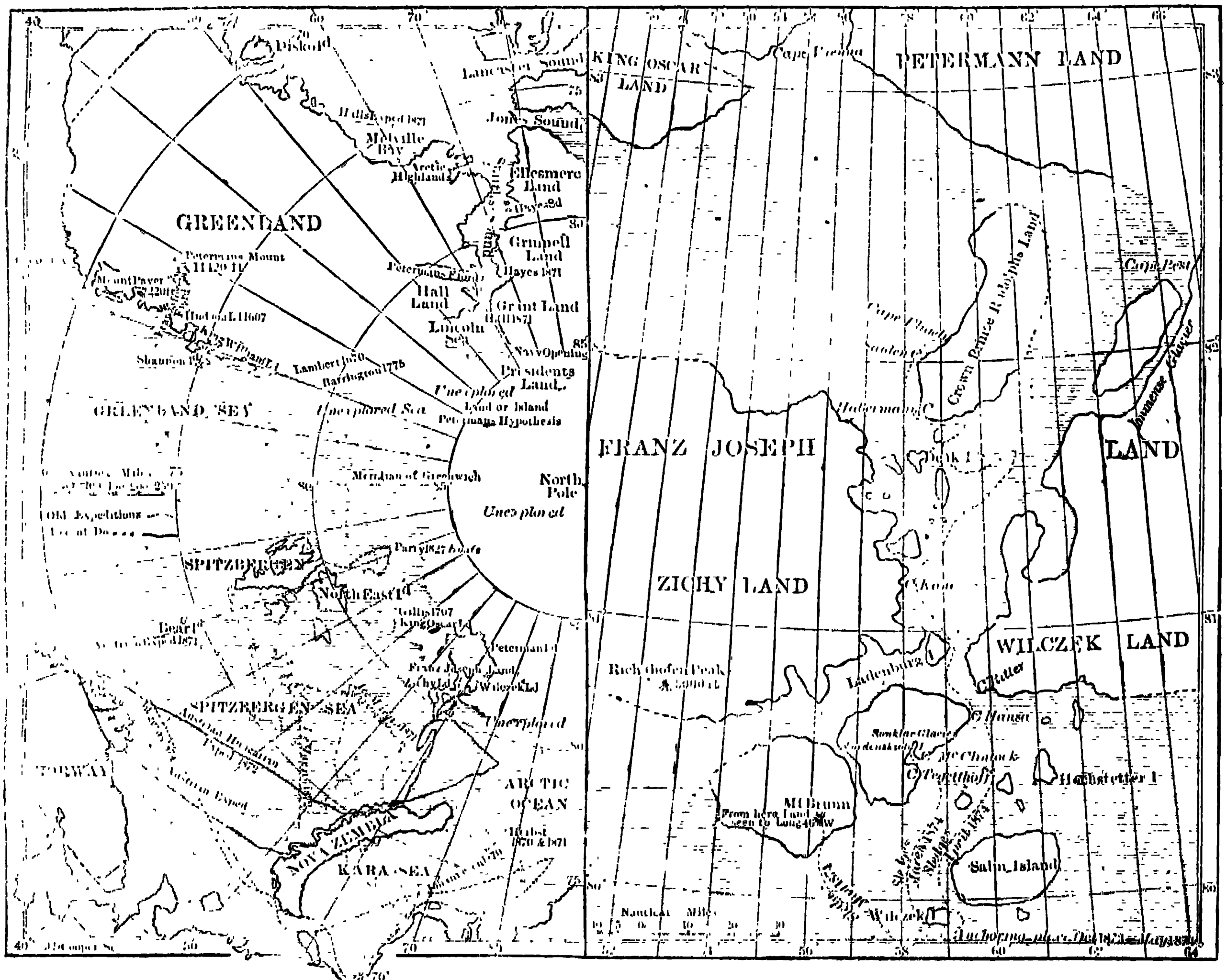
No general with his victorious army returning from battle could have been welcomed with greater enthusiasm and cordiality than this little band of twenty-two men. For though they only come home from a North Polar expedition, people instinctively feel that the accomplishment of the *Tegetthof's* voyage is a heroic deed. To gain a battle, hetacombs of precious human lives must be sacrificed; here all came safely back. A battle does not demand greater endurance and courage, for the battle of the *Tegetthof* lasted two years. We think of the times of Columbus and Vasco da Gama, of their discoveries and return to Palos and Lisbon. It is true the Austrian expedition did not find an America or an India; but Columbus, and other great discoverers, did not really discover more than Weyprecht and Payer. Before Columbus traversed it, men believed that the western ocean was not navigable, and similar ideas prevailed with more reason concerning the sea just explored. One of the first describers of polar regions, Scoresby, had, in the year 1820, in his famous work, drawn a line over the whole sea from Bear Island, in 74½° N. lat., to Novaya Zemlya, and said, with confidence, "Here is the icy barrier where navigation must end;" and the unknown regions beyond this line were regarded by mariners with pious dread. The Austrian expedition has torn away the veil up to 83° N. lat., and has narrowed the undiscovered parts of the earth by a space of 8° to the north.

They had to stay at Novaya Zemlya for four weeks, and work their way out of thick ice for at least 240 geographical miles before reaching Cape Nassau, which was the starting-point of the expedition. They then encountered the most terrific dangers which can befall a polar expedition, for they were hemmed in by an ice floe, and shut up for fourteen months in pack ice, and driven about in the Siberian icy ocean. Eventually a tolerably safe place in the open ice was found for the second wintering, when the crew heroically divided themselves, the better to explore the land they had discovered.

The comrades of the *Tegetthof* have shown themselves worthy to take rank with their prototypes, Ross, Parry, M'Clintock, Kane, Hayes, and Hall, for they have made a breach in a place where no one since Barents, during all the 300 years of arctic discovery, had attempted an attack. The explorations are here shown on a map constructed from the original preliminary sketch by Payer, with the geographical constants drawn by Dr. Petermann.

The nature of the North Pole is not so fully known but that the learned world is still fighting as to whether it is land or water, or an everlasting ice-cap, stretching like our home glaciers, or obeying other laws, or dissolving and opening under the influence of the warm sun, air, or water, like our own seas. And since any expedition can only discover a proportionally small part of the great unknown arctic world, there will always be some people ready with ape-like wisdom to pronounce against any endeavour to unfold the laws of nature within the inner polar regions. Dr. Petermann has for ten years urged that Germany should send out a polar expedition far into the great European polar sea, and is particularly anxious to get the whole breadth of the European North Sea explored from East Greenland to Novaya Zemlya, north of Bear Island.

The results of this expedition have marked an epoch in various ways. First by the drift for fourteen months in the ice-floe. Such driftings have occurred before on a larger scale, as in the case of De Haven, M'Clintock, the *Hansa* people, and the *Polaris* people; but all these expeditions drifted south—the *Polaris* crew from 80° N. lat. to 53°. But entirely new and full of significance for physical geography, is the circumstance that the path of the Austrian expedition was uninterruptedly towards the north.



The map on the left shows the state of polar exploration up to the end of September 1874; that on the right is the newly-discovered land.

The following instances also show that the icy sea is navigable. Hall's expedition north from Smith's Sound proved that from Tessiusak in 73° 20′ N. lat., through the ill-famed Melville Bay, Smith's Sound, Kennedy Channel, Robeson Channel, to 82° 11′, was reached with ease in eleven days, the distance being more than 700 miles; and the best officers of this expedition declare their united conviction that they could easily have reached further north. The Karis Sea, formerly called the Ice-cellar of the North Pole, has proved to be completely navigable. Admiral Sir E. Parry, after Sir James Clark Ross perhaps the most experienced of all polar travellers, going north from Spitzbergen, came to the conclusion that a ship might sail to 82° N. lat. without encountering a piece of ice. Admiral Beechey, one of the most excellent and perhaps the most scientific sea captain who has ever lived, said in 1831 that he considered the navigation of the coast of the arctic region as practicable.

Dr. Petermann then asks: Is the experience of the Austrian expedition a measure of the resistance offered by the ice in the icy sea just explored? Are all the results which are opposed to it, from the former expedition of Weyprecht and Payer, not worthless? Is it worth nothing that numerous Norwegian fishermen in sailing boats have been able to sail round Novaya Zemlya since 1869 and penetrate far into the Siberian ice sea, always finding it navigable and quite free from ice? Is it not worth remembering that at the time Payer and Weyprecht found the unwonted accumulation of ice by Novaya Zemlya, the western half of the great sea, *quite against the rule*, was free from ice, so that the Norwegian fishermen were able for the first time to reach the mystic Gillisland, which is King Charles Land? Under certain unfavourable conditions of wintering, the north side of Novaya Zemlya is, without doubt, as difficult and impossible for navigation as the north side of Spitzbergen, or Cape Horn, or the Cape of Good Hope, or the English Channel, or the mouth of the Weser.

The *Tegetthof* is a small steamer of 220 tons, and though her supply of coal was necessarily small, it proved ample, for steam could only be got up three times in the first three weeks of the voyage. And thus, as in all recent voyages, rowing boats proved themselves better fitted than steam launches for exploring work. In the summer of 1872, the journey from Cape Nassau could not be made in a straight course, but Count Wilczek's journey in the sailing vessel *Isbjörn* demonstrated that it was practicable by following a tortuous course.

The best and first account of the results of the Austrian expedition, in relation to their bearing on the present state of knowledge of arctic geography, and of the current setting into the icy sea from the south, is given by Dr. Joseph Chavanne, and is as follows:—

"The rising polar sun of 1874 lighted up and discovered a new land, now named Franz Joseph Land, and the expedition set off to explore it in sledges. They found the country to be a narrow, far-extending foreland, divided from Greenland by a wide arm of the sea now named Austria Sound. It is mountainous, approaching to a plateau, with steep conical mountains 5,000 feet high, covered with enormous glaciers. This newly discovered land stretches for more than 15° of longitude, and bounds the horizon with mountains as far as the eye can carry to the north and west. In 83° N. lat. they sighted Cape Vienna, the most northern point visible, and Cape Pesth, one degree further south, and finding the great glaciers impassable in this latitude, they returned to their icebound ship. Imperative necessity compelled them to abandon their vessel upon its icy platform, and they set out to return to Europe with four sledges. They travelled on for sixty-nine days, and then fell in with the Russian schooner *Nikolai*, who landed them at Vardoe, in the north of Norway. Austria Sound, and other fjords, were filled with icebergs. They met with no trace of human inhabitants, and remark that animal and plant life is scarce and small in the south."

Twenty-two years ago Dr. Petermann indicated on a map of the arctic regions the polar extension of the Gulf Stream. Though generally regarded at the time merely as the hypothesis of a German philosopher, the unwilling drifting of the *Tegetthof* in the ice has proved that the principal northern branch of the Gulf Stream washes the west and northern coast of Novaya Zemlya. Between the west coast of Novaya Zemlya and the east coast of Spitzbergen, enormous masses of ice press westward with the polar current flowing from New Siberia Island and the Siberian rivers, and penetrate wedge-like into the Gulf Stream. The temperature of Franz Joseph Land in the winter of 1872-73 was 40° Réaumur.

The remarkable correspondence between the coasts on the two sides of Greenland supports the conjecture that the polar land, if not subdivided into a number of islands by ramifying arms of the sea, is at least deeply indented by fjords, as is demonstrated by Hall's discovery of Petermann's Fjord on the west coast of Greenland and Franz Joseph's Fjord on the east.

PHYSICS AT THE UNIVERSITY OF LONDON*

II.

TURNING then first of all to the Regulations for Matriculation in the University of London, we find that the knowledge of Physics that is required is specified under four heads: namely, *Mechanics; Hydrostatics, Hydraulics*, and *Pneumatics; Optics;* and *Heat*, which last, until quite recently, was included in the examination in Chemistry; and the whole is accompanied by a general qualifying note to the effect that "the questions in Natural Philosophy will be of a strictly elementary character." The particulars, which are given under each of the above general heads, read as if they might have been copied, as they stand, from the table of contents of an elementary treatise on Natural Philosophy published about a hundred years ago. I have examined them often and carefully, and have never found a tittle of internal evidence to show that they were drawn up within the present century; and yet we know that they are the work of a University, not yet forty years old, which owes its very existence to the demand for educational progress, and began its career—without indeed the wealth or the prestige of its older compeers—but also without the trammels of tradition and ecclesiasticism, which render it so difficult for them to advance with the times. It is not a sufficient defence of the antiquated character of these Regulations to say that the very nature of the examination to which they refer would make the introduction of new discoveries entirely out of place, and that, in point of fact, the fundamental doctrines relating to the subjects in question were as fully established a hundred years ago as they are now. This is so nearly true (except in the case of *Heat*), that it would not be worth while to dispute it; but my objection is not to the want of novelty in the subjects enumerated, but to the want of perception, which the manner of the enumeration indicates, of the possibility of progress or improvement in the ways of teaching long-known truths. Instead of giving prominence to general principles in such a way as to suggest to teachers the use of easy and comprehensive methods, these Regulations cut up the subjects to which they relate into a number of detached propositions, of greater or less generality, which teachers and students, who accept these Regulations as their guide, generally treat as independent units of knowledge each of which is to be put into a separate hole of the memory. It would be wearisome, but not difficult, to illustrate my meaning by particular examples; the substance of it is that this examination does not encourage good teaching of the elementary parts of Physics, but induces candidates to trust to memory almost to the total exclusion of any attempt at thinking. My opinions on this subject have not been formed *à priori*, but have been forced upon me by reading examination papers and by trying to teach in what I believed to be the best way. It is in general nearly hopeless to try to get students, who have the fear of the London Matriculation Examination before their eyes, to make any serious attempt to understand the principles of Mechanics; but they often show a lamentable willingness to learn statements of them by heart, and when they go up for examination they know a great deal and understand next to nothing. They know that in a lever of the first kind, whose weight is neglected, the power is to the weight as the weight's arm to the power's arm; that when a heavy body falls from rest, the spaces described in successive seconds are as the natural series of odd numbers; and they are ready at the shortest notice to write down the formula for calculating the specific gravity of a solid body heavier than water; but it is only in the rarest possible cases that they can be got to reproduce the reasoning by which these results are connected with general physical principles. The industry displayed in acquiring separate fragments of information about Physics is often extremely creditable; but it is impossible not to regret that the same method should be employed in learning what is called Science, as in learning the dates of accession of the Kings of England.

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* Introductory Lecture delivered at the opening of the Session of the Faculties of Arts and Laws and of Science, in University College, London, on Monday, Oct. 5, 1874, by G. Carey Foster, F.R.S., Professor of Physics. Continued from p. 508.

A still more curious instance of the antiquarian tendencies of the University of London is afforded by the Regulations for the Degrees in Science, which were instituted as recently as 1860. It might have been supposed that when the Senate had once determined to make so great an innovation in the traditional usages of English Universities as to grant Degrees in Science, they would have been impelled by the spirit of their own act to frame such regulations for the examinations as should be in full agreement with the present state of science. I recognise as fully as anyone the impropriety of introducing anything that can fairly be called a new discovery into examinations such as those for the London degree of Bachelor of Science, but between such a course and that adopted by the University there is a very broad *via media*. In order to obtain the degree of Bachelor of Science, a candidate requires, after Matriculation, to pass two further examinations, called respectively the First and Second B.Sc. Examination. At the former, a paper is set in what is called "Mechanical Philosophy," and another in "Natural Philosophy," the Mechanical Philosophy being a repetition of the subjects called Natural Philosophy at Matriculation, with a few additions, chiefly under the head of Optics, while the Natural Philosophy includes *Heat*, *Electricity*, and *Magnetism*. At the Second B.Sc. Examination there are two papers in "Mechanical and Natural Philosophy," which are explained by the Regulations to mean nearly the same parts of Statics, Dynamics, Hydrostatics, Pneumatics, and Geometrical Optics as those prescribed for the First B.Sc. Examination, but treated a little more fully, and with the addition of a very little Acoustics, a little Physical Optics, and a smattering of Astronomy. The details given in the Regulations under each of these general heads are open to the same general criticisms as those which I have already ventured to make upon the mode in which the requirements in Natural Philosophy are stated in the Regulations for Matriculation; in fact, those parts of the subject which are common to the three examinations are specified in very nearly the same words in each case, the difference being that a slightly more mathematical treatment of them is expected at the higher examinations. In each case there is the same failure to suggest general and comprehensive points of view, and the same enumeration of particular examples, as though they were of equal importance with the general principles which they illustrate. It is just as if, in an examination in Latin or Greek, instead of its being stated that candidates would be required to answer questions in grammar, lists of particular nouns and verbs were given with the announcement that candidates might be required to give the declensions or principal parts of any of these. But these Regulations are defective not only in form but in substance—not only in spirit but in matter. Without going into further details in order to justify this statement, I may mention, by way of illustration, that at the First B.Sc. Examination, under the head *Electricity*, there is no distinct reference to any of the quantitative laws of the science, and it is only by a laxity of interpretation quite unsuited to the subject that an obscure allusion to Ohm's Law can be discovered—the great law expressing the connection between the strength of an electric current and the nature of the circuit which it traverses; while, under *Heat*, no liberality of interpretation could detect the smallest trace of the Dynamical Theory of Heat. This last omission, however, ceases to be surprising when we find the steam-engine classed with the common pump and forcing-pump; the hydrostatic press, the barometer, and the air-pump, under *Hydrostatics*, *Hydraulics*, and *Pneumatics*. It might have been natural a hundred years ago to look for Newcomen's atmospheric engine among such company; but, even then, James Watt had nearly converted the old atmospheric engine into the modern steam-engine.

But there is no need to enter upon any minute investigation of the Regulations for these examinations, in order to be convinced that their effect upon the study of Physics must be unfavourable. The small amount of encouragement which they hold out to pursue this subject seriously is shown by the fact that a London Bachelor of Science is not required to have any more knowledge of heat, magnetism, or electricity than candidates for degrees in Medicine are required to show at the "Preliminary Scientific (M.B.) Examination," which, in the usual course of things, is taken one year after Matriculation; and also by the fact that the papers in Mechanical and Natural Philosophy set at the Second B.Sc. Examination are identical with those set in the same subjects at the Second B.A. Examination. I have no fault to find with one side of this last arrangement; I have already given reasons for considering that Physics ought to occupy an important place in general education, and, from this point of view, the physical subjects for the Second B.A. Examination are, on the whole, not injudiciously chosen; but it is certainly strange that a degree in Science should not imply any greater acquaintance with the fundamental principles of Mechanics than is demanded of candidates for the degree of Bachelor of Arts, the examination for which is in the main literary and classical. Another fact, which may be regarded as a sort of experimental proof that the examinations of the University of London do not promote such a study of the elements of Physics as can serve as the foundation for a more advanced study, is that for the last five years a special examination for Honours in Experimental Physics has been held in connection with the First B.Sc. and Preliminary Scientific (M.B.) Examinations, at which a Medal and a Scholarship of 40*l.* a year, tenable for two years, are offered to the most deserving candidate in case of his exhibiting sufficient absolute merit, but hitherto the scholarship and medal have never been awarded, and only once has a candidate obtained a First Class at this examination.

The other examinations of the University of London into which Physics enters to a greater or less extent, are, that for the degree of M.A. in Branch II., and those for the degree of D.Sc. in certain branches; but as these examinations come at a stage of a man's career at which it may be supposed that his methods of study are not greatly influenced by the regulations of examining bodies, and as, moreover, the Regulations of the University relative to these degrees do not go much into detail, there is no reason for dwelling upon them in connection with my present subject.

I do not propose to say much about that part of the examinations for which the Examiners, rather than the Senate, are directly responsible; but there are one or two considerations which, although sufficiently obvious, it may be worth while to point out. First of all, however, I shall venture, presumptuous as it may be thought, to make one remark on the choice of the persons best fitted to be examiners. It has more than once been claimed as a special merit of the University of London, that the examiners are not teachers, or at least that they have nothing to do with teaching the candidates whom they are called upon to examine. Fortunately, however, this is not the case. As a matter of fact, the great majority of the examiners are always teachers, and it may quite well happen, at least at some of the smaller examinations, that a majority of the candidates have been pupils of a single examiner. But I venture to think that, instead of this state of things being considered as a more or less regrettable accident, it ought to be recognised as natural and desirable. If the real object of the examinations be to promote good teaching and sound learning, it is most important that, in setting the questions, the examiners should always keep in view their probable effect in giving direction to the studies of future candidates; and there can be no doubt that the men who are both most likely and most able to do this are those whose constant business it is to consider how the subjects in which they have to examine can be best brought before the minds of learners. Moreover, it is very difficult for examiners who are not also teachers, and teachers accustomed to pupils who are at about the same stage of advancement in their studies as the majority of the candidates, to know what amount of knowledge it is reasonable to expect. A man, however minute his own knowledge of his subject may be, generally soon forgets the exact steps by which he acquired it; and, unless he is in frequent contact with the minds of learners, he is no longer able to tell what, at any particular stage, it is creditable to know, and what it is disgraceful to be ignorant of. And again, though this perhaps is a less important consideration, the necessity which a teacher is under of periodically reviewing the whole round of his subject, is a great help towards a varied selection of questions.

With regard to the particular kind of questions which are most desirable in examinations like those of the University of London, I wish to say only a very few words. If the general considerations to which attention has been drawn in an earlier part of this lecture are of any value, it follows at once that examination questions in Physics ought to be selected with a view to testing the reasoning power and not the memory of candidates. If what are called *book-work* questions are admitted at all, they should be such as will bring out the power of reproducing trains of consecutive reasoning, and bringing facts to bear on the establishment of general conclusions, and not the power of simply recollecting individual facts. It may be said that such questions would be unfairly difficult. I can only say in reply that, if teaching were what it should be, I do not believe that this would be the case; but if it should be found to be so, I maintain that the inference is, not that any other style of examining in Physics should be adopted, but that the whole subject should be dropped. A late very distinguished member of the University once said that, in the case of candidates for Matriculation, all that could be fairly required at the examination in Physics was evidence of "correct acquisition." It would in my opinion be only a little more absurd to say that all that ought to be required at an examination in Geometry is evidence of the "correct acquisition" of Euclid. If Physics is not a subject upon which the intelligence should be exercised from the very beginning, it seems to me to be a waste of time to teach it at all.

The consideration of the kind of questions that are best fitted to be of use in promoting improved methods of teaching and learning, suggests a remark which bears upon the distinction that has often been pointed out between the subjects which it is desirable to teach and those which are most suitable for examinations. In the particular case of Physics, I am inclined to think that the very elementary parts of such branches as Heat and Electricity are not well adapted to form the subjects of examinations like those we are considering, where the examiners have no means of knowing the exact points of view from which the matters dealt with have been presented to the candidates. My reason for this opinion is the difficulty in these subjects of setting questions which require anything more on the part of candidates than mere exercise of the memory, and which at the same time are not unreasonably hard. As a practical inference, it appears to me that, if the amount of acquaintance with Heat, Electricity, and Magnetism represented by the London Regulations for the First B.Sc. Examination (supposing the regulations to be strictly interpreted) is all that can be fairly demanded at this stage of a student's progress, it is at least a question whether these subjects should not be deferred until a more advanced stage, when something more than descriptions of apparatus or the solution of arithmetical problems might be reasonably required.

If any of my audience have listened to this lecture with the consciousness that they will soon be going up to one or other of the examinations that I have been discussing, it may very possibly seem to them that I have been pleading throughout for making these examinations more difficult. To any to whom this seems to be the tendency of my remarks, I would venture to suggest one or two further considerations. In the first place, I fully admit that if examinations in Physics were to be such as I have advocated, that is, if they required candidates to *think*, while the teaching of Physics remained what too much of it now is—a mere loading of the *memory*—candidates would, no doubt, have a hard time of it; but the whole intention of what I have said is that examinations should be improved *in order* that teaching may be improved through their influence; and I believe that if teaching were what it should be, good examinations would be found to be no more difficult than bad ones. I may also observe that after all the precise degree of difficulty which an examination presents is not the most important consideration even for an intending candidate; what it really is important, not only for candidates but still more for those who regulate examinations, to consider is, what is the permanent educational value of the work which an examination requires, and not simply what is the amount of work needed. I have many a time in reading examination papers felt sincerely sorry for the writers when I saw how much labour they had evidently gone through in order to learn nothing—nothing that is of real use—and have thought how much the same amount of labour might have accomplished if it had only been better directed; and I beg leave to assure any who look upon examinations from the under side, that I have no wish whatever to add to the quantity of work that is already required of them; but what I do wish sincerely is, that whatever work they may be required to do in preparing for examinations may be such that they will be intellectually better and stronger for having done it. It cannot be too often repeated that degrees and university distinctions are of no more value in themselves than the Queen's head upon the coin: unless the metal is genuine, the stamp only makes it into a lying counterfeit. This has been urged upon students over and over again; what I shall be glad if this lecture tends in any degree to accomplish, is to press the same truth upon the attention of our University authorities. It is important for them to remember that a man is not really either better or worse for all the degrees that they can give him; and that their boast should be, not in the length of their lists of graduates, but in the extent to which they have promoted "a regular and liberal course of education."

NOTES

One of the first results of the Transit of Venus expedition with regard to the geological aspect and vegetation of a comparatively little known island, comes to us from Rodrigues, and is contained in a communication from Mr. J. B. Balfour to Dr. Hooker, under date, from the above island, of August 23, 1874. As a proof of the inhospitable, or rather the uncivilised nature of the island, it is stated that the party belonging to the expedition were warned in Mauritius before starting for Rodrigues that they must take everything from the former island that they would be likely to require as it would be impossible to get anything at Rodrigues, and even labour is most difficult to be obtained. After providing himself with various articles of absolute necessity, Mr. Balfour started from Mauritius, and after a voyage of exactly a week, landed at Rodrigues on August 18. The appearance of the island as seen from the vessel while steaming along near the coast, presented few features which could be looked upon as evidencing any large amount of granite entering into its constitution. On the contrary, the columnar structure of the cliff lines, both on the coast and in the interior, along with the terraced aspect of many of the ridges separating deep ravines, cutting far back into the island, clearly showed that, whether the main mass of the island were granite or not, certainly at some period of its history it had been the scene of very extensive volcanic action. On the 19th of August an excursion was made across the island to survey the channel on the south side. The vegetation on the island is very rank. The trees do not grow to any great size, and in most places do not form thick forest, but are scattered singly over the slope of the hills. It is only in the deep valleys and gorges that they grow into thick forest. The commonest tree seems to be the Vacoa (*Pandanus*), of which there are probably at least four species. The under-scrub is very dense and very spiny, which renders walking through it by no means a pleasant task. Neither ferns nor mosses appear to be very abundant, but lichens are pretty plentiful, especially in their pulverulent state; and in many places the basalt was nearly covered with white powdery patches. The basalt forming the rocks near Port Mathurin is, in its unweathered condition, a very beautiful compact stone, with large crystals of several minerals scattered through it. The difficulties in landing upon the island seem to be very great, owing to the extent of the coral reefs.

The Yorkshire College of Science at Leeds was opened without ceremony on Monday, by the delivery of one of the introductory lectures by Mr. A. H. Green, the Professor of Geology and Mining. The other professors—A. W. Rücker, Dr. T. E. Thorpe, and W. Walker—give their introductory lectures during the course of the present week, and the teaching of the session will then be proceeded with. Very suitable buildings have been obtained, containing ample accommodation, which has been fully utilised for lecture-rooms, laboratories, &c., which are well furnished with the necessary appliances. Still, as Mr. H. Brown said, "they must look forward to having a noble building like that of Owens College, Manchester;" if the College is to maintain its position and to advance at all, it cannot but end in this. The number of students enrolled is as yet small, but, no doubt, will gradually increase. Prof. Green, in his address, spoke of the importance of a thorough training in abstract science as the necessary groundwork of a technical education. "Before they could understand," he said, "the practical application of a science, they must be master of the science itself. What was sometimes understood as technical education was a sheer impossibility, and a contradiction in terms. They could not explain the technical application of a science without first laying down the scientific groundwork on which it rested. A science like geology could not be taught piecemeal. Technical education in the popular sense was a misnomer, because the teaching which would limit the range of a man's vision to the subjects of which he could see the use did not deserve the name of education, the very essence of which was the strengthening of the intellect by mental exercise. It was his earnest wish that he might be able to give a teaching which in the end would have an important bearing on their practical occupations, and enable them to manage their mining, engineering, and other pursuits—in the conduct of which a knowledge of geology came in useful—better than if they knew no geology at all. But if he was to succeed in doing so, he must begin by telling them many things which at first sight would seem to be of no practical value whatever." With such a spirit as these words indicate, animating the professors of this new college, the best results may be expected from their teaching.

A meeting of some of the friends of the late Dr. Stoliczka was held in the rooms of the Zoological Society on Friday, the 16th inst., at which it was determined to obtain, by subscription, a bust, to be presented to the Asiatic Society of Bengal, of which society Dr. Stoliczka was for some years before his death one of the honorary secretaries. A committee was appointed to act in concert with one previously formed in Calcutta, and upwards of 50*l.* was subscribed in the room for the purpose mentioned. Subscriptions, we are informed, will be received by Messrs. Grindlay and Co., 55, Parliament Street.

The *Athenæum* announces that the *Contemporary Review* for November will contain an account of a new scientific discovery by Prof. Tyndall.

Amongst the works which are progressing favourably at the Observatory of Paris we may mention the determination of the velocity of light, by MM. Fizeau and Cornu. These able physicists are using for their second station the Tower of Montlhéry. The light is transmitted to Montlhéry through a refracting telescope of 12 in. and returned to the Observatory with a 7 in. The distance between the Observatory and Montlhéry being 26 kilometres, the total distance traversed by the ray of light is 52 kilometres. The space of time required amounts to something less than one-thousandth of a second.

The polishing of the great reflecting telescope is almost completed. The immense lens to be covered with silver by the Leon Foucault process, is nearly ready. It is said that everything will be finished by the beginning of May 1875.

At Agram, the chief town of Croatia, a Croatian University was formally opened on Oct. 19 by the highest magistrate of the land, who is called the Ban, and exercises a kind of viceregal power on behalf of the Emperor of Austria. The University is to be called "Francis-Joseph," from the name of its founder. The Rector delivered a very able oration, summarising the progress of the higher studies in Croatia from the time when Maria Theresa established the Society of Sciences. Many delegates of foreign or other Austro-Hungarian Academies were present at the ceremony (Krakow, Berlin, Bologna, Pesth), and delegates from the Servian societies of learning. It is expected that the new University will play a most important part in the civilisation of the East, and be indeed the vanguard of European science in that direction.

Much remains to be done in this respect if the information we collect from Levantine papers be correct. It appears that in one of the principal islands of the Greek Archipelago some poor women have been imprisoned and starved, under the charge of sorcery. They were arrested for having attracted a host of locusts to their native land. The locusts not retreating, the persecution was extended to the husbands of the wretched creatures.

The International Commission of Geodesy will hold its next meeting in Paris, in accordance with the decision come to at Dresden, where it held its sitting this year. The Government will assign it a public building for its meetings.

Mr. J. E. Taylor, F.G.S., has discovered a buried forest in the Orwell. The forest is represented by a layer of peat containing trunks, leaves, and fruits of the oak, elm, hazel, and fir, associated with which are the remains of the mammoth. A bed of freshwater shells containing species not now living in the Orwell underlies the peat. Mr. Taylor remarks that this submarine forest is contemporaneous with others along the coast which existed previous to the depression separating England from the Continent.

Mr. J. E. Taylor, who has done so much to create an interest in science in Ipswich, is to give a course of twenty lectures (free) in that town during the coming winter, on "Plants: their Structures and Uses."

An important discovery has been made at Highwood, near the village of Ashill, in Norfolk, consisting of a vast collection of Roman remains in an oak-lined well, 40 ft. deep. The Norfolk and Norwich Archæological Society visited the spot on the 16th inst., when the well, under the superintendence of Mr. Barton, was emptied of its contents by a number of workmen. The well contains a great variety of articles, the most abundant being urns, of which about 100 have been obtained; more than fifty of these are perfect, and many of most beautiful form and ornamentation. There is considerable doubt as to the purpose which these wells were intended to serve; there are other two at Ashill, and others have been found elsewhere.

The *New Quarterly Magazine* for October contains, with other articles of general interest, a paper by Mr. Richard Jefferies on "Small Farms." The writer notes the enormous development of science in modern farming, saying: "New plans, new inventions and discoveries follow each other in constant succession. The capabilities of agriculture seem inexhaustible. The number of clever and intellectual men who turn their attention to it multiply daily. It has its colleges, its professors, its students, and it would require a great volume to describe the machinery alone that has been contrived of late years, and is now in the market. The chemistry of agriculture would fill many more such volumes. Geology, botany, entomology, almost all the sciences, are pressing forward to its aid." Deprecating, in the present state of agricultural science, the advantages of small farms, Mr. Jefferies goes on to say: "The utility of bringing up a race of students instructed in chemistry, geology, entomology, mechanics, &c., in agricultural colleges, with the assistance of professors, if they are afterwards to be placed on small farms, is a matter of much doubt; they would have no room for the exercise of their attainments. . . . Whether it be considered from the tenant's own side, or from the labourer's, or from the landlord's, the balance of argument appears to be indisputably in favour of large farms. To the nation, to the ever-increasing population, the large farm offers a greater present produce, and possibilities of still further development. The political economist, who judges the prosperity of an occupation by the amount of capital attracted towards it, must also decide in its favour, for capital will never flow into small farms."

We commend to the notice of the Goldsmiths' Company the letter from "A Jeweller's Assistant" in yesterday's *Times*. Let us hope that this, as well as the other wealthy City Companies, are now waking up to a sense of their responsibilities, and that they will lose no time in utilising the immense wealth at their disposal, and which has hitherto been utterly wasted, in the promotion of technical—which ultimately means scientific—education. Let them not provoke a "City Companies' Commission."

On the 12th inst. was opened the London School of Medicine for Women. The Council had determined that no inaugural address should be given, and thus a day which the future may possibly prove to have been one of no little importance passed by unmarked more than by the fact that the first lecture had been given in a Medical School devoted exclusively to the teaching of the female sex. The school is now in full working order, and women can receive an education fitting them to practise medicine. The services obtained by this school need not stop short at preparing women for the medical profession. There are many branches of science allied to the study of Medicine, Chemistry, Botany, Comparative Anatomy, &c., in all of which a course of lectures is given as part of the medical education. These subjects are separately adopted by men as a means of gaining a livelihood. A knowledge of any one of these subjects is attainable equally by women as by men, and there is no reason why women should not achieve a scientific reputation and earn a fair competency by engaging in these studies and by imparting their knowledge to others.

It is announced by the last Indian mail that a smart shock of earthquake was experienced in Central Ceylon early on the morning of the 19th of September, at five o'clock. The vibration was considerable, and was accompanied by a dull rumbling sound. The motion was from east to west, apparently; the rumbling was decidedly in the east. The shock appears to have been felt in the centre of the island only. Earthquakes in Ceylon are such rare events that this one has had a good deal of attention bestowed upon it.

We would draw the attention of our readers to the excellent introductory lecture delivered by Prof. Leoni Levi at King's College, on "The Educational and Economic Value of Museums and Exhibitions," which is published in the *Society of Arts Journal* for the 16th inst. He gives many valuable suggestions as to the uses for purposes of popular teaching which might be made of our museums. He thinks that London is still deficient in museums, and states that there are at least some two hundred cities and boroughs which have taken no step to secure museums and public libraries for themselves.

The *Augsburg Allgemeine Zeitung* of the 22nd inst. gives the following facts and statistics from the various University Calendars just published:—The University of Berlin shows the largest attendance, having had, in the summer term of 1874, 2,980 students and 187 professors. While this University had for a time the second place and Leipzig the first, the order is now reversed, and Leipzig follows with 140 professors and 2,800 students. Then comes Halle, with 1,055 students and 95 professors; Breslau, with 1,036 students and 107 professors; Munich, with 1,031 students and 114 professors; Tubingen, 921 students and 84 professors; Würzburg, 901 students and 58 professors; Heidelberg, 884 students and 104 professors; Bonn, 858 students and 98 professors; Strassburg, 667 students, and 81 professors; Konigsberg, 603 students and 76 professors; Greifswald, 540 students and 58 professors; Jena, 493 students and 69 professors; Münster, 451 students and 27 professors; Erlangen, 442 students and 51 professors; Marburg, 440 students and 62 professors; Giesgen, 342 students and 58 professors; Freiburg, 297 students and 52 professors; Kiel, 210 students and 62 professors; Rostock, 132 students and 38 professors. In these numbers the non-matriculated students are also included. The German-speaking Universities outside the German Empire show the following attendance:—Basle, 163 students and 62 professors; Berne, 332 students and 63 professors; Zurich, 331 students and 75 professors; Dorpat, 708 students and 67 professors; Graz, 932 students and 68 professors; Innsbruck, 615 students and 52 professors; Prague, students (?) and 122 professors; Vienna, 3,615 students and 227 professors. Vienna, therefore, is at the present time the largest German University.

M. Hurquerlot, a gentleman who was largely interested in railway speculations, died a few months ago and left a legacy of 24,000*l.* to the city of Paris for the purpose of establishing a railway school. But the sum, although very large, having been considered insufficient for the purpose, the Municipal Council has been reluctantly obliged to reject the money, which will revert to the lawful heirs.

More than 18,000 young men have gone successfully through their examinations, and have been admitted as volunteers for one year in the French army. About half of that number have been rejected as not having received a sufficient education. The report of the examiners shows an improvement in the mean capacity of candidates. Many young men are admitted, without having to pass previous examinations, Bachelors of Arts, Sciences, or Letters, Pupils of Public Schools of Arts and Public Works and Mines, and Beaux Arts, and a few other institutions. The number of the volunteers of that class is about 4,000. Each volunteer has to pay besides a sum of 60*l*. to the Government. Education must be combined with money, in order to shorten the service in the remodelled French army.

THE study of "seaweeds" is probably affected as much by the general public as that of fish; and whether or not the great mass of people who visit the Brighton Aquarium and other similar resorts really go there with any idea of becoming more intimately acquainted with the wonders of the deep, there is no doubt that the exhibition of varieties of ocean plants would be as popular as that of fish. A seaweed growing in water is very different from seaweed cast up on the shore, and a careful selection and arrangement of specimens would greatly enhance the interest of the tanks, while at the same time their presence would prove beneficial to the fish. We recommend the hint to the notice of the authorities of the Brighton, Crystal Palace, and Southport Aquariums.

AN Industrial Exhibition is to be held at Leighton Buzzard for a short time about Whitsuntide 1875. The district to be represented is limited to a radius of twenty miles around Leighton Buzzard, and the proceeds of the exhibition will be devoted to the formation of a lecture fund for the purpose of securing courses of high class (largely scientific, we hope) public lectures in connection with the Working Men's Society, and the increase of the Society's library.

TO increase the general instructiveness of their Museum, the Leeds Philosophical and Literary Society have published Descriptive Guides to the different collections of which it is composed. That on the British Birds, by Mr. L. C. Miall, is before us, containing a short and instructive account of each species exhibited. This method of combining instruction with amusement is one which it would be well if other public institutions were to adopt, instead of leaving their collections, often valuable ones, for the idle gaze of the many uninitiated, and the careful study of the but too few special students of special branches of science and art.

IN many parts of the coasts of this country where fish are abundant, enormous quantities are used as manure: in Cornwall and on the Eastern coasts this is particularly the case, but no means are adopted to convert the fish into a manufactured manure, and they are thrown, as caught, on the land. The same remarks apply to America. But recently a system has been adopted in certain localities by which the fish are prepared specially for manuring the land. At Lucages, Long Island, a factory has recently been established for preparing the surplus quantities of "Menhaden" caught near there. The oil is first extracted from the fish, and the residue is prepared in a certain manner and converted into "fish guano," which has a good reputation as a fertiliser.

ARRANGEMENTS have been made for placing on board one of the steamers running between Liverpool and New York, one of the "American Aquarium Cars," a newly invented contrivance for transporting live fish, which has succeeded very well in long overland journeys, and by means of which it is hoped to effect a useful interchange of living fish of various kinds between this country and America. There are many American fish which might with benefit be introduced into England, and we at the same time might transport to the other side of the Atlantic some varieties of fish which are not found there.

THE exhibition of insects in the Orangery of the Tuileries Gardens, Paris, has been brought to a close. The distribution of prizes took place on October 5. The higher medals were taken by a Viennese *savant* for a magnificent atlas exhibiting all the organs and forms of *Phylloxera vastatrix*; but the Phylloxera question is left open, and no reasonable solution appears to have been presented. Lectures were delivered daily on entomology, and every one of them was illustrated by projections with the solar microscope. Almost every kind of insect was thus presented to the public. The exhibition proved wonderfully successful; more than 20,000 persons paid the entrance fee, and the number of free tickets issued amounted to 30,000 in the brief space of twelve days.

WE have received a lecture on "The Life and Works of Dr. Priestley," delivered in Paris at the time of the celebration of the Priestley Centenary by M. W. de Fonvielle. It is published by Auguste Ghio, and is dated 1875.

THE additions to the Zoological Society's Gardens during the past week include a Bengalese Leopard Cat (*Felis bengalensis*) and a Common Paradoxure (*Paradoxurus typus*) from India, presented by Capt. W. Reynolds; a Great Eagle Owl (*Bubo maximus*), European, presented by Lord Londesborough; an Indian Fruit Bat (*Pteropus medius*) from India, presented by Dr. Stafford; a Monteiro's Galago (*Galago monteiri*) from Angola; a Tooth-billed Pigeon (*Didunculus strigirostris*) from the Samoan Islands, deposited; two Geoffroy's Doves (*Peristera geoffroyi*) from the Island of Fernando de Noronha, and a Gentoo Penguin (*Pygoscelcs taeniatus*) from the Falkland Islands, new to the collection, purchased.

KENT'S CAVERN[*]

BEFORE entering on this, their tenth Report, the committee desire to express their deep sense of the great loss they have sustained in the decease of Prof. Phillips. No member was more regular in his attendance at the meetings of the Committee or felt a livelier interest in the investigation with which they are charged. On March 18, 1874—little more than a month before his lamented death—though suffering from a severe cold, he visited the cavern, when he carefully inspected those branches of it which had been explored, and expressed his admiration of the clearness and importance of the evidence bearing on the question of human antiquity which had been obtained.

The investigation has been pursued without intermission during the entire period which has elapsed since the meeting at Bradford in 1873; the mode of operation has been that described in previous Reports and followed from the commencement; the work has been performed in the most satisfactory manner by the same workmen; and the superintendents have continued their daily visits and carefully recorded the results from day to day.

The interest felt in the exploration by the inhabitants and visitors of Torquay has suffered no abatement, and the superintendents have conducted a large number of persons through the cavern, including the members of the South-western Branch of the British Medical Association during a meeting of that body held at Torquay, and also the members of the Birmingham Natural History and Microscopical Society whilst on a scientific excursion to South Devon.

During May 1874, an arrangement was made with the superintendents by Prof. A. Newton of Cambridge, for Mr. Slater, one of the naturalists of the Rodrigues Transit Expedition, to spend some time in the cavern, studying the mode of exploration followed there; it being probable that he might have to explore some very interesting caves which exist in the island. Mr. Slater reached Torquay on the 1st of June, when everything was done to facilitate his purpose, and he spent some days watching the men at work.

Live rats continue to present themselves in the cavern from time to time, and prove occasionally to be very troublesome. Thus, in October 1873, one carried off six candles during the afternoon from a spot selected because it was believed to be inaccessible even to rats, and which had been used as the candle store during a period of three years without any previous loss of the kind; and in the same month another ate through one of the workmen's basket between the hours of nine and one, and carried off his dinner. A large number have been captured during the last twelve months.

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[*] Tenth Report of the Committee for Exploring Kent's Cavern, Devonshire. (Abstract.)

During summer, bees have frequently been seen and heard in the innermost branches of the cavern, very far beyond any glimmering of day-light.

The branches of the cavern in which the researches have been carried on since the ninth Report was presented in 1873, are those known as the Long Arcade, Underhay's Gallery, the Cave of Inscriptions, and Clinnick's Gallery. The exploration of the former two has been completed, but the work is still in progress in the latter. The deposits have been, in descending order, like those reported last year: first, or uppermost, the Granular Stalagmitic Floor, from 12 to 30 inches in thickness; second, the Cave Earth, which has nowhere been more than two feet deep, but has rarely exceeded one foot, and has occasionally thinned out altogether; third, the Crystalline Stalagmitic Floor, usually exceeding the Granular Floor in thickness, but which had, in certain places, been partially broken up and removed by some natural agency before the deposition of the cave earth; and, fourth, or lowest known, the Breccia, consisting of materials not derivable from the cavern hill, and which appear to have been introduced through openings or mouths of the cavern at present choked up and unknown. The depth of this deposit has not been ascertained, as its bottom has nowhere been reached.

In the Long Arcade the surface of the upper or granular stalagmite was occupied with large natural "basins," some of them 12 inches deep, such as have been described in previous Reports. The following points of interest were noted respecting them during the progress of the work:—

1. The stalagmite forming their walls was harder and tougher than that surrounding them; whilst that composing their bottom was comparatively soft and friable.
2. The walls were traceable through the entire thickness of the Stalagmitic Floor; in other words, during the entire deposition of the floor, basins had existed in it, the bottom rising with the walls, but at a slower rate.
3. The water which filled them in rainy seasons passed down through the bottom in three or four hours at most.
4. Immediately beneath most of the basins there was an almost continuous interspace of about half an inch in height between the bottom of the stalagmite and the top of the cave earth; caused, no doubt, by the finer particles of the deposit being carried by the percolating water through interstices to a lower level.

It happened that the exploration of that part of the Arcade in which the basins were thus numerous was carried on during a wet season, when the water, passing through the Stalagmitic Floor, as just mentioned, caused two or three slips of the deposits beneath. In the largest of these a well-rolled flint nodule was found with some remains of animals. No such specimen had been previously seen within the cavern.

At the junction of the Long Arcade, the Cave of Inscriptions, and Clinnick's Gallery, there is a huge boss of stalagmite, in the form of the frustrum of an oblique cone, 43 feet in basal circumference, 14 feet along the slant side—which forms an angle of 40 degrees with the horizon, and thus gives a vertical height of fully 13 feet for the mass—and contains probably no less than 630 cubic feet of stalagmite. Its base consists of the older or crystalline stalagmite, and the upper portion, without any intervening cave earth, of the granular variety, which not only surrounded and completely encased the former, but, by flowing in copious sheets, formed the thick Granular Floor, spreading without a break and for great distances in every direction. Though inscriptions exist in various parts of the cavern, this mass is, with perhaps the exception of the almost inaccessible Crypt of Dates, more thickly scored with names, initials, and dates than any other equal area within the cavern; and hence it has acquired the name of the Inscribed Boss of Stalagmite. The inscriptions occupy its outer or most exposed semi-surface, where in certain places they form a network. Letters of all sizes, from some fully three inches in height to others as small as ordinary writing, cross each other and thus add to the difficulty of decipherment. Some of them were cut with great care and finish, and must have occupied a large amount of time, whilst others were but hasty scratches. It seems to have been somewhat fashionable to surround the inscriptions with rectangular parallelograms, varying from 6·5 to 3·75 inches in length, by 5·5 to 3·5 in breadth. In at least one or two cases the cutting of the parallelogram preceded that of the inscription, as the latter extends beyond the boundary. Not unfrequently several names occur together, whether within a parallelogram or not, and in each such case the entire work seems to have been performed by the same hand. At least four of them belong to the seventeenth century, and the earliest of the series, so far as at present known, is that of "Peter Lemaire, Rich. Colby, of London, 1615." Amongst the names is that of "Deluc," probably the well-known geologist, "Champernowne," that of a well-known old Devonshire family, and several prevalent in the immediate district.

In 1846 the Torquay Natural History Society appointed a committee of three of its members, including the two superintendents of the present exploration, to make some very limited researches in the cavern. One of the spots which that committee selected was in Clinnick's Gallery, immediately adjacent to the incribed boss, where they made a very small excavation. The materials dug up on that occasion were, as usual at that time, thrown on one side, where they remained until removed in May last when they were taken out of the cavern by the present committee. Before this was done, the surface of the mass was carefully examined to ascertain what thickness had been reached by the stalagmite which, as the superintendents well knew, had been accreting on it during the last twenty-eight years. The result was a small film not thicker than ordinary writing-paper, and limited to two examples, each covering not more than two or three square inches.

Underhay's Gallery was found, when the work of exploration was completed, to be about 20 feet long, from 2·5 to 7 feet wide, and from 6 to 7·5 feet in height, the latter measurement being taken from the bottom of the excavation. Before the committee commenced their operations there, its mouth was almost entirely closed with large masses of limestone. Notwithstanding this, the late Mr. Underhay, for several years guide to the cavern, forced himself into the gallery about fourteen years ago, even though after passing the entrance, he must have found the Granular Stalagmitic Floor within a foot of the roof in certain places. Here he found *on* and *sticking into* the stalagmite a few small bones which he succeeded in bringing out, when they were found to be phalanges of human feet. Though these specimens did not appear to be of an antiquity at all approaching that of the cave-hyæna and his contemporaries, the superintendents, who were familiar with them, very carefully watched the progress of the work, in the hope of finding some further traces of the skeleton; and on reaching Mr. Underhay's very limited diggings they met with a series of bones, all *on* and *in* the stalagmite, some of which were certainly human, whilst others were as clearly not so. The whole were at once sent to Mr. George Busk, a member of the committee, who has been so good as to forward a report on them to the effect that twenty-eight of the specimens are human, and include an astragalus, a navicular bone, a trapezium, a patella, a metatarsal, an ecto-cuneiforme, phalanges of fingers and toes, and fragments of humeri, ribs, and vertebræ; that they appear to be the remains of an adult individual of small size and delicate make, and probably of a female, on which point, however, it is impossible to speak positively; that the bones are not necessarily of any very remote antiquity; that the remaining specimens are not human, but belong to small sheep or goat, probably the former, which must have been of the smallest Welsh type.

When the very contracted character of this gallery, prior to its excavation by the committee, is borne in mind, it is difficult to understand how the remains were introduced. There were neither potsherds nor charcoal, nor, in short, anything suggesting that the bones were the remnants of a body disposed of by cremation, such as were met with in another branch of the cavern in 1872; nor were there any marks of teeth on the bones such as might have been expected had they been taken thither by a carnivorous animal, or the relics of a skeleton buried or secreted there, of which all other portions had been carried off by some carnivore.

The only noteworthy objects met with in the Granular Stalagmitic Floor during the year were a tooth of bear, fragments of bone, one considerable "find" of coprolites, and charred wood on two occasions, all of which occurred in the Long Arcade.

The Cave Earth has yielded during the period under notice 187 teeth of various kinds of mammals, of which 94 occurred in Underhay's Gallery, 63 in the Long Arcade, 20 in the Cave of Inscriptions, and 10 in Clinnick's Gallery; 102 belonged to hyæna, 36 to bear, 27 to horse, 8 to elephant, 8 to fox, 4 to rhinoceros, 1 to lion, and 1 probably to wolf. There were also numerous bones and fragments of bone, of which some were gnawed, and a few appear to have been burnt. Coprolites were very abundant, 69 distinct "finds" having been met with during the twelvemonth. They sometimes, though rarely, consisted of a solitary ball, whilst at others upwards of 20 were lying together and not unfrequently cemented into large lumps. Occasionally the amount of matter of this kind found in a single day was sufficient to fill a large basket.

Fifteen specimens of flint and chert were also met with in the cave earth, 6 of them occurring in the Cave of Inscriptions, 5 in Underhay's Gallery, 2 in the Long Arcade, and 2 in Clinnick's Gallery. The finest of the series is No. 6324, found December 30, 1873, in the second foot-level, beneath the floor of granular stalagmite from 2 to 2·5 feet thick. It is a very symmetrical tongue-shaped tool, fashioned with much labour out of a chert nodule, and worked to an edge all round the perimeter except at the butt end, where portions of the original surface remain on both faces. It is 3·8 inches long, 2·3 inches in greatest breadth, 1·5 in greatest thickness, and convex on both faces, from each of which several flakes have been struck. Though fashioned out of a nodule, which is very rarely the case amongst the cave-earth implements, its symmetrical form and comparatively high finish are highly characteristic of the era to which it belongs.

No object of interest of any kind has been found in the Crystalline Stalagmitic Floor during the year; but the Breccia lying beneath it has been by no means unproductive. In this oldest of the cavern deposits the remains have been, as heretofore, exclusively those of bear, so far at least as is at present known, and in addition to a large number of bones, including a considerable portion of a skull, 441 teeth have been met with in it, of which 149 were in the Long Arcade, 115 in Underhay's Gallery, 91 in the Cave of Inscriptions, and 86 in Clinnick's Gallery.

Twentys-six pecimens of flint and chert have also been found in this deposit, of which 10 occurred in the Long Arcade, 6 in Clinnick's Gallery, 5 in Underhay's Gallery, and 5 in the Cave of Inscriptions.

The finest of the series (No. $\frac{1}{6411}$) and indeed one of the finest the cavern has yielded from the commencement, was found April 23, 1874, in the fourth or lowest foot-level, with 1 tooth of bear, fragments of bone, and a small chert flake (No. $\frac{2}{6411}$) which had probably been rolled. It measures 4·5 inches in length, 3 inches in greatest breadth, 1·1 inch in greatest thickness, is very convex on one face, slightly so on the other, retains a portion of the original surface near the butt end, and is rudely quadrilateral in form, with the angles rounded off. Several flakes have been struck off each face, and the edge to which it has been reduced along its entire margin, except at the butt end, is by no means sharp; its surface is almost completely covered with an almost black, probably manganesic smut, whilst a slight chip near the pointed end shows it to consist of a very light-coloured granular chert. Several lines betokening planes, probably of structural weakness or perhaps of fracture, entirely surround it. If it has really been fractured, it must have occurred where the tool was found, and the parts have been naturally reunited without being faulted. Its character as well as its position shows that this fine implement belonged to the era of the Breccia.

This specimen is of considerable interest, both on account of the lines which cross its surface and of the position it occupied.

Amongst the flint implements found in Brixham Cavern that known as No. 6—8 has attracted considerable attention, and has been described and figured by Mr. John Evans, both in his "Ancient Stone Implements" and in the "Report on the Exploration of Brixham Cave." It was found in two pieces, the first on the 12th of August, 1858; the second, 40 feet from it, on the 9th of the following September; and it was not until some time after the latter date that the late Dr. Falconer discovered that the two fragments fitted each other, and when united formed a massive spear-shaped implement. The lines on the Kent's Cavern specimen just described show that it had either been fractured where it was found, or, what seems more probable, that it is traversed by planes of structural weakness, such that a slight blow would break it into two or more pieces, which a stream of water would easily remove and probably separate, and thus produce a repetition of the Brixham case.

The Kent's Cavern tool was found in a small recess in the wall, just within the outer or wider entrance of Clinnick's Gallery, within a very few feet of the Inscribed Boss of Stalagmite, and, as has already been stated, in the fourth foot-level of the Breccia, that is, at the greatest depth in the oldest of the cavern deposits to which the present exploration has been carried, and is thus wonderfully calculated to take the mind step by step back into antiquity.

First, very near the spot occupied by the specimen, there rises a vast cone of stalagmite, which an inscription on its surface shows has undergone no appreciable augmentation of volume during the last two-and-a-half centuries.

Second, prior to that was the period spent in raising the greater portion of this cone, which measures upwards of 40 feet in basal girth, reaches a height of fully 13 feet, and contains more than 600 cubic feet of stalagmitic matter.

Third, still earlier was the era during which the cave earth was introduced, in a series of successive small instalments with protracted periods of intermittence, when the cavern was alternately the home of man and of the cave hyæna, and the latter dragged thither piecemeal so many portions of extinct mammals, as to convert the cave into a crowded palæontological museum.

Fourth, further back still, was the period during which the base or nucleus of the cone or boss was laid down in the form of crystalline stalagmite.

Fifth, and earliest of all, was the time when materials not derivable from the immediate district were carried into the cavern, through openings now probably choked up, entirely unknown, and the direction in which they lie but roughly guessed at, when apparently the cavern-haunting hyæna had not yet arrived in Britain. At an early stage in this earliest era man occupied Devonshire; for prior to the introduction of the uppermost four feet of breccia, one of his massive unpolished tools, rudely chipped out of a nodule of chert, found its way into a recess in the cavern, and having a character such as to show that it must have lain undisturbed in the same spot until it was detected by a committee of the British Association.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for September contains the following papers communicated to the Society:—On the products of the decomposition of castor oil, No. 3. On the decomposition by excess of alkaline hydrate, by E. Neison. The action of sodium hydrate mixed with water gives rise to the formation of a mixture of an alcohol and a ketone on distillation. The alcohol is an octylic alcohol, which the author regards as the secondary alcohol methyl-hexyl carbinol $H\left\{\begin{array}{l}C_6H_{13}\\ CH_3\\ H\\ OH\end{array}\right.$ The ketone is methyl-hexyl ketone. The olefine derived from the alcohol has been examined. The supposed heptylic alcohols of Städeler and Petersen turn out to be a mixture of octylic alcohol with methyl-hexyl ketone.—On the action of nitrosyl-chloride on organic bodies, Part I. On phenol, by Dr. W. A. Tilden. The phenol is oxidised to quinone, which substance is then converted into chloramil, the nitrosyl-chloride being completely reduced—a certain amount to ammonium chloride.—Aniline and its homologues, &c., in coal-tar oils, by Watson Smith.—On the action of chlorine, bromine, &c., upon isodinaphthyl, by Watson Smith and James M. Poynting. The action of chlorine gives rise to the formation of a tetrachlorinated derivative, $C_{20}H_{10}Cl_4$. Bromine replaces seven atoms of hydrogen, giving rise to the compound $C_{20}H_7Br_7$. With concentrated sulphuric acid a conjugate acid is formed, of which the barium and sodium salts have been examined. Both the chlorinated and brominated derivatives are amorphous powders.—On hydrogen persulphide, by William Ramsay. The persulphide was prepared by first saturating alcohol with ammonia gas, and then passing sulphuretted hydrogen through the solution. The ammonium sulphide thus produced was shaken up with sulphur and a solution of strychnine in alcohol added. White crystals having the formula $C_{21}H_{22}N_2O_2H_2S_3$ separate out on standing. These crystals treated with sulphuric acid yield hydrogen persulphide in the form of oily globules, but the yield is small, and the separation from the sulphuric acid extremely difficult. The author finally adopts the old method of pouring calcium persulphide into hydrochloric acid. Analyses of the compound thus obtained gave results indicating a formula between H_2S_7 and H_2S_{10}. The properties of the persulphide have been examined in some detail.—The journal contains its usual valuable collection of abstracts.

Geological Magazine, Oct. 1874.—The original articles contained in this number are (1) a continuation of Mr. Lechmere Gupp's article on West Indian Tertiary Fossils; (2) Notes on he impression of *Palæontina oolitica* in the Jermyn Street Iuseum, by A. G. Butler, including a discussion on its zoologi- al place; (3) The structure of Lambay Porphyry, by Prof. Hull, a aper read before the Geological Society of Ireland; (4) Geo- gy of West Galway and South-west Mayo, by S. H. Kinahan, n epitome of a communication made to the British Association; 5) Note on the Phonolite of the Wolf-rock, by S. Allport.

Zeitschrift der Œsterreichischen Gesellschaft für Meteorologie, ept. 15.—This number contains a description of the self-acting rinting barometer, invented some years ago by Mr. Hough, irector of the Observatory at Albany, U.S., but not very well nown in Europe. By the employment of electricity, the baro- eter will record movements as slight as ·0005 in., and will rint not only curves, but a register as well, at any required in- rvals per hour. The apparatus does not require frequent tention.—Among the *Kleinere Mittheilungen*, we have a otice of M. Goulier's aneroid, provided with a scale of heights eside the scale of millimetres. It is contended against this rangement that two scales make a correct reading less easy, at the precision of the scale of heights, where the intervals etween the lines are not equal, must be doubtful, and that the orrection proper to each aneroid would not be easily applied the scale of heights.—M. Mühry has an article On differences temperature as a cause of latitudinal oceanic circulation. He aintains that two causes are at work, each of which tends to roduce latitudinal circulation, namely, the diminution of the rce of gravity towards the equator, and the increase of mperature with consequent expansion and diminished specific avity. The lower strata of cold water rise at the equator wards the surface, and a corresponding descent of warm upper rata must take place in polar regions. With regard to the ebated question on the point of greatest density of sea-water, holds it to be the same as that of fresh water, and late experi- ents bear out his argument on this subject.

Bulletins de la Société d'Anthropologie de Paris, fascicule vi. tome 1874.—In the closing number of the Society's last year's Re- orts, the remains found at Solutré, near Macon (in August 1873), rmed a large proportion of the subjects of the papers. The sumed find at Solutré of a metallic ring, enamelled green, on e of the phalanges of the skeleton which had been uncovered the presence of MM. de Quatrefages, Broca, and nearly fifty her persons, has been rejected by the Society as unworthy the nsideration of scientific men; while M. Broca, in a detailed port of the investigation in which he on that occasion took the incipal share, has clearly shown the impossibility of such a ng escaping his notice had it been present. M. Broca in an- her paper considers at length the characteristics of the various ania which have been found at Solutré since the spot was first amined by MM. de Ferry, Arelin, de Freminville, Lortet, and hers, and described by the two first-named in their work "Le âconnais Préhistorique" (1870): and he draws attention to the rious prehistoric and historic epochs at which interments have en made at Solutré, and by which the question of the true age these remains has been surrounded with greater difficulties an belong to the palæontological character of any other similar ot in France. The prehistoric crania at Solutré are in a very d condition; but they present a large capacity of nearly 1,600 bic centimetres, with an index of only 82·87. Platycnemic biæ, with the characteristic columnar femures, were found, but . Broca seems on the whole to assume that the earliest dis- vered men of Solutré belonged to a mixed race similar to those the Belgian caves of La Lesse. M. Hamy has demonstrated at brachicephalic crania supervene at Solutré on the dolicho- phalic, as at Cro-Magnon.—M. Topinard read a paper on the stems of craniometry, in which he endeavoured to show by the ntradictory cranial determinations arrived at in reference to the olutré and other recent finds, how important it is to show a efinite method of cranial measurement. In the discussion hich followed, M. Rochet opposed the notion that craniometry art is based upon individual fancy more than scientific accuracy; hile M. Broca admitted the defects of the present methods.— note by M. P. Bert, on the twin monster known as the double- eaded nightingale, led to a general discussion on double or twin onsters, and to the inquiry whether they were produced from vo distinct embryos or from one germ endowed *ab initio* with e property of doubling or reproducing certain parts. It was enerally admitted that external circumstances have no power to duce embryonic duality.—Madame C. Royer, in a very original aper on the origin of different human races, protested against e hypothesis which derives all European races from Asia, and endeavoured to show by the geological history of the earth that man must have appeared first on the great Austral continent, and radiated thence to the other continents. Her novel views were received with marked attention, and it was felt that if she should be able to adduce sound geological proof of her statements, her hypothesis of primary human migrations will be as important as it is original. Till she fulfils her promise of clearly expounding her theory, her arguments cannot, however, be accepted as more than ingenious speculations.

Revue d'Anthropologie, tome iii. No. 3.—M. Paul Broca supplies us in this number of the review, of which he is sole editor, with a comprehensive history of the course of observations which have led to the enunciation of the theory propounded by him (in the *Bulletins de la Soc. d'Anthrop. de Paris* for January and February 1874) in regard to the hygrometric properties of fossil crania. After considering the important but inadequately appreciated experiments made in 1859 by M. Welcker in reference to this point, he enters at great length into the consideration of the numerous carefully conducted series of observations and measurements by which he was led to the conclusions which he has adopted, and his paper constitutes, therefore, a most valuable *résumé* of the physical as well as the palæontological bearings of the subject.—M. Bérenger-Feraud, surgeon in the French navy, gives, as the result of personal investigation, an account of the different tribes who occupy the shores of the Casamanca in Inter-tropical Africa. This stream, on which the Portuguese and French have a few scattered trading stations, is one of the numerous rivers of Western Africa which take their source on the western slope of the Fonta-Djalon mountain-ranges. The author considers the Casamanca peoples under the three heads of primary or autochthonic, invading, and immigrating races; the first including the Feloups and Bagnouns, the second the Belantes, Mandingues, and Peuls, and the last the Onolofs, Saracolais, Machouins, Taumas, &c.; and passing each in review, he describes their habits, the form of fetichism followed by each, and their general social condition. Among the Balantes he notes the singular custom of making the duration of marriage responsibilities dependent on the conservation of the "pagua" or festive garment given to the wife by the husband on the occasion of their wedding. The woman who wishes to secure a divorce has merely to wear out her pagua as fast as she can, and then present it in a tattered condition to her family, on which she obtains her release from the power of her husband. Among the same people a charge of sorcery, which is very common with them, can only be met by a public appeal to the ordeal of the "mançone" or "ago broumedion," which is said to be a decoction from the bark of a poisonous tree, and which it would appear is always fatal unless rich gifts have secured the copious watering of the draught by those to whom its preparation is confided.—MM. Daleau and Gassies give a report of the appearances presented by a cavern at Jolias, in the canton of Bourg (Gironde), which, on its recent exploration, yielded in a stratum of red diluvium below a solid calcareous bed, a rich deposit of bones, many of which had been cleft, but none of which belonged to extinct species, numerous flint implements similar to those found at Moustier and Solutré, but no remains of pottery, except in the upper part of the cavern, where they had probably been thrown aside long after the disuse of the cavern.

Zeitschrift für Ethnologie, heft vi. 1873.—The first article in this number gives some interesting details in regard to the almost unknown Red Indian tribe of the Tulus of Panama, believed to be the descendants of the Churchures, who successfully resisted the attempts made by the Spanish Conquistadores for their subjection. Representatives of these people appeared last year at Bogota with the object of making complaints against the collectors of caoutchouc, cacao, and elephant nuts, who had come to their woods and been guilty of violence against the tribe, and it was from his examination of these men that the author drew up his report.—In a suggestive article by Prof. Bastian on the nature of ethnology and its relations to geography, the author points out how essential the knowledge of physical laws is to the right comprehension of ethnology, which is in itself less a zoological history of man than a history of the geographical distribution of man considered in relation to physical habits, which, like the physical characteristics of different faunas and floras, depend primarily upon geographical position, and secondarily on climatic, geognostic, and other analogous conditions.—Herr Virchow laid before the society several skulls of the Goldi, a hitherto almost unknown tribe, who occupy the shores of the Amoor at the point where the Sangari and the Ussuri join the main stream. He is of opinion that these people are more nearly allied to the Tunguses than to the Esquimaux, the crania in his possession being remarkable for their high brachicephalic form and large cranial capacity.—In a letter from Dr. Bleek, addressed to the society, the writer draws attention to the peculiarity evinced by the Bushmen of becoming fairer and lighter in skin after they have for a time enjoyed good and abundant food, with the comforts of civilised life. This special characteristic he regards as a proof of the difference between these peoples and the negro races of South Africa, and as an evidence of their nearer affinity with more northern tribes. Dr. Bleek at the same time expresses his opinion that the dances by moonlight, which are systematically practised by the South African tribes, are connected with some form of moon-worship; while Dr. Fritsch, on the other hand, believes that these dances are in no way religious, and are simply called forth by the charm of tropical moonlit nights.—Herr Virchow exhibited some stone implements or wedges precisely similar to the so-called flint knives, which we are accustomed to assign to the Stone Age; yet these were of modern fabrication, being made in the present day in Syria, where they are used, amongst other purposes, to keep the different parts of the Syrian threshing machine (*tribulum*) in their places.

Astronomische Nachrichten, No. 2,007, contains the observations of position and magnitude of 148 comparison stars and 13 minor planets, made with the meridian circle at Berlin.—No. 2,008 contains the positions of 108 more stars, reduced to the mean equinox of 1870, and the positions of 20 planets, made by the same instrument. With the Berlin refractor the positions of some 58 planets have been determined, and some of them have been observed on a number of nights.—In No. 2,009 L. Schulhof gives an ephemeris and the following elements of Comet III. 1874, discovered by Coggia on the 19th of August:—

$$\begin{aligned} T &= \text{July } 5{\cdot}16629 \text{ Berlin time.} \\ \pi &= 347^\circ\ 20'\ 2'' \\ \Omega &= 213^\circ\ 12'\ 15'' \\ i &= 28^\circ\ 25'\ 41'' \\ \log.\ q &= 0{\cdot}15831 \end{aligned}$$

M. Geelmuyden gives elements of Coggia's first comet of 1874, and assigns a period of 10,445 years.—D'Arrest contributes a number of spectroscopic observations of Secchi's types III. and IV.—Ormond Stone gives a note on certain expressions of the distance of a comet from the earth, and a paper on Brunnow's method of correcting the orbit of a comet.—Dr. Holetschek gives an ephemeris of Borrelly's comet, the two last positions of which are—

	R.A.	DEC.
Oct. 29 ...	6h. 21m. 9s.	+ 50° 37′·6
Nov. 2 ...	6h. 5m. 11s.	+ 47° 36′·7

and an ephemeris of Coggia's comet of the 19th of August—

Oct. 29 ...	5h. 0m. 41·8s.	− 0° 12′ 55″
Nov. 2 ...	4h. 48m. 46·4s.	− 1° 49′ 50″

Memoria della Società degli Spettroscopisti Italiani, August.—Father Secchi contributes a paper discussing the theory of solar spots set forth by Galileo, and he compares the theories and observations of Wilson, Kirchhoff, Faye, and Gautier. Tacchini adds a note discussing M. Faye's theory of the formation of solar spots, and opposing it on the ground that spots and faculæ seem to accompany eruptions. Tacchini also gives notes on the positions of the chromosphere where magnesium vapour was observed in January last, and he also mentions the position of prominences accompanying spots at the limb, and containing metallic vapours. The magnesium line and 1474 occur most frequently.—Notes and measurements of the comet (Coggia) made by E. Dembwoski with a 7-inch Merz, together with drawings of the nucleus, appear in this number.—Schiaparelli contributes a note on the new star observed in Sagittarius in 1690. He thinks it the same as the variable star S Sagittarius, R.A. 287° 40′, Dec. 19° 18′.—Tacchini gives a table with notes showing the number of meteors, with their brightness, observed in each fifteen minutes from 10h. 30m. to 13h. 15m. on the 9th, 10th, and 11th of August last. The radiant point

	R.A.		DEC.
On the 9th, of 35, was	2h. 52m.	...	54° 56′
" " of 3, "	2h. 14m.	...	55° 43′
" 10th, of 71, "	2h. 53m.	...	54° 40′
" " of 11, "	2h. 14m.	...	56° 14′
" 11th, of 14, "	2h. 53m.	...	54° 43′
" " of 10, "	2h. 14m.	...	56° 20′

SOCIETIES AND ACADEMIES

MANCHESTER

Literary and Philosophical Society, Oct. 6.—Rev. William Gaskell, M.A., vice-president, in the chair.—On the ossiferous deposit at Windy Knoll, near Castleton, by Mr. Rooke Pennington, LL.B.—On some teeth from a fissure in Waterhouses Quarry, in Staffordshire. Mr. Pennington called attention to some teeth of a bison (*Bos priscus*) from a fissure in a quarry at Waterhouses. The animal had evidently fallen in while coming to drink at the river Hamps. It had been erroneously described as an Irish elk.—On the extent and action of the heating surface for steam boilers, by Prof. Osborne Reynolds, M.A.—Dr. Joule made a further communication respecting his mercurial air pump described in the Proceedings for Dec. 24, 1872, and Feb. 4, Feb. 18, and Dec. 30, 1873. He had successfully made use of the glass plug proposed in the Proceedings for Feb. 4, 1873. This he constructs by blowing out the entrance tube and grinding the bulb thus formed into the neck of the thistle-shaped glass vessel. To collect the pumped gases he now employs an inverted glass vessel attached to the entrance tube and dipping into the mercury in the upper part of the thistle glass.

WINCHESTER

The Winchester and Hampshire Scientific and Literary Society held the first meeting of its sixth session on Oct. 19; Dr. Heale, treasurer, in the chair.—The Rev. F. Howlett, F.R.A.S., delivered an introductory address, noticing many of the more important discoveries made during the past year in various departments of scientific research.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—Report of the Weather Telegraphy (E. Stanford)—Annual Report Aeronautical Society of Great Britain (Hamilton and Co.).—Journal of the Iron and Steel Institute, 1874 (Spon).—Note on the Perception of Musical Sounds: J. G. McKendrick, M.D (Neill and Co.). Flora Cravoniensis: John Windsor, F R.C.S., F.L S, &c (Cave and Co.).—The Contrast between Crystallisation and Life: John E Howard, F.R.S, F L.S., &c. (Hardwicke).—Atomism: Dr. Tyndall's Theory Examined and Refuted: Rev. Prof. Watts, D.D. (Mullan, Belfast).—Brixham Cavern: N. Whitely, C.E. (Hardwicke).—Philosophy, Science, and Revelation: Rev. C. B. Gibson, M.R.I A., &c (Longmans).

AMERICAN.—Nomenclature of Diseases: J. M. Woodworth, M D (Washington)—Proceedings of the American Association for the Advancement of Science.—Notes on Ophidiidæ, &c.: F. W. Putnam.

FOREIGN.—L'Astronomie Pratique: C André and G. Rayet (Gauthier-Villars, Paris).—Einige Bemerkungen über den Werth, welcher im Allgemeinen den Angaben in Betreff der Herkunft menschlicher Schädel aus dem ostindischen Archipel beizumessen ist: Dr. Meyer (Wien).—Uber neue und ungenugend Vögel von New Guinea und den Inseln der Gelvincks Bai: Dr. Meyer.—Manuel de la Cosmographie der Moyen Age: A. F. Mehren (Copenhagen).—Neues Handworterbuch der Chemie: Dr. H. von Fehling (Viewig and Son).—Die Geologie: Franz Ritter von Hauer (A. Holder, Wien).—Normale Zeiten für den Zug der Vögel: K. Fritsch (Wien).—Fosselen Bryozoen: Prof. Dr. A. E. Roon Reuss (Wien).—I precursori di Copernico nell' antichita: G V. Schiaparelli (W. Hoepli).—Osservazioni Astronomische e Fisiche: G. V. Schiaparelli (W. Hoepli).

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DIARY OF SOCIETIES.

London

MONDAY, November 2.

Royal Institution, at 2.—General Monthly Meeting.

TUESDAY, November 3.

Zoological Society, at 8.30.—Report on the Recent Additions to the Society's Menagerie: The Secretary.—Exhibition of some Rhinoceros Horns obtained by Mr. Everett in Borneo: A. R. Wallace.—Liste des Oiseaux recueillis par M. Constantine Jelski dans la partie centrale du Perou occidental: M. L. Taczanowski.—On points in the Anatomy of the Parrots which bear on the Classification of the Sub-order: A. H. Garrod.

WEDNESDAY, November 4.

Geological Society, at 8.—Notes on the Comparative Microscopic Rock-structure of some Ancient and Modern Volcanic Rocks: J. Clifton Ward.—The Glaciation of the Southern Part of the Lake-district, and the Glacial Origin of the Lake-basins of Cumberland and Westmoreland; Second Paper: J. Clifton Ward.

Microscopical Society, at 8.—On some Himalayan Leaf-fungi: Dr. Fleming and M. C. Cooke.

Gresham Lecture, at 7.—On the Ear: Dr. E. S. Thompson.

THURSDAY, November 5.

Chemical Society, at 8.—On Methyl-hexyl Carbinol: Dr. C. Schorlemmer.—On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids: Dr. C. R. A. Wright.—Further Researches on Bilirubin and its Compounds: Dr. J. L. W. Thudichum.—Action of Bromine in the presence of Water on Bromopyrogallol and on Bromopyrocatechin: Dr. Stenhouse

Linnean Society, at 8.—Revision of Asparagaceæ: J. G. Baker.—Monographic Sketch of the Durioneæ: Dr. M. T. Masters.

Leeds

MONDAY, November 2.

Geological Association, at 8.—The Glacial Drift of the Neighbourhood of Leeds: J. H. Moore.

TUESDAY, November 3.

Naturalists' Field Club and Scientific Association, at 8.—Exhibition of Specimens and Conversation.

Torquay.

TUESDAY, November 2.

Natural History Society, at 12, noon.—Introductory Address, On Carcinology: Rev. T. R. R. Stebbing.

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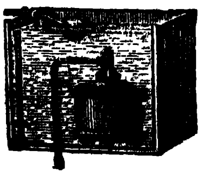

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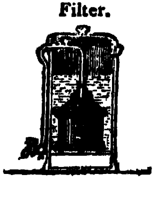

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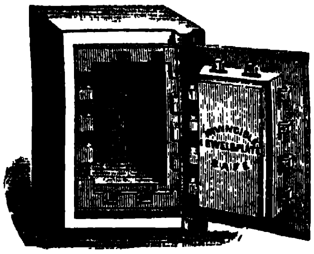

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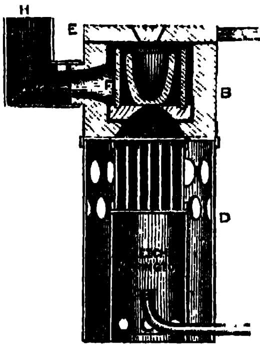

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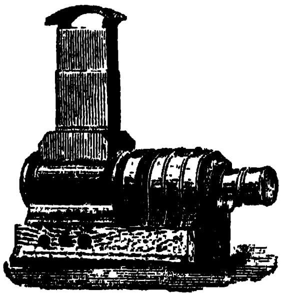

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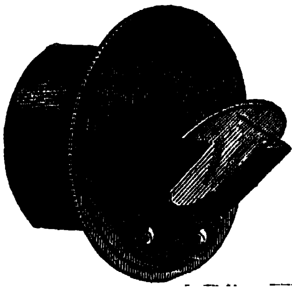

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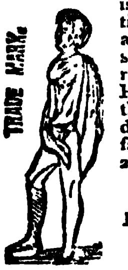

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THURSDAY, DECEMBER 3, 1874

SAXBY'S "BIRDS OF SHETLAND"

The Birds of Shetland, with Observations on their Habits, Migration, and Occasional Appearance. By the late Henry L. Saxby, M.D., of Balta Sound, Unst. Edited by his brother, Stephen H. Saxby, M.A. 8vo., pp. 398; eight plates. (Edinburgh: 1874.)

JUST as no country can show such a number of works on Ornithology as our own,* so no branch of our fauna has received anything like the same degree of attention, which the existence of such works implies, as birds. These works are of various grades of excellence, as might naturally be expected, but there are few that do not contain more or less valuable matter, and none that can be safely neglected by ornithologists; while some, as Mr. Stevenson's "Birds of Norfolk," Mr. Gray's "Birds of the West of Scotland," and of course Thompson's "Birds of Ireland," rise to a very high order of merit. The book now before us—the late Dr. Saxby's "Birds of Shetland,"—does not, indeed, nearly reach the standard of those just named as a whole; but in some respects it does not fall far below it, because the locality of itself gives an importance to the subject which no imperfections can impair—and the work certainly labours under several manifest and serious defects. It will be enough to mention three of them. First, there is the deplorable fact of the author's premature death, and the posthumous publication of his book consequent thereupon; for though his brother has doubtless done all in his power to discharge the duty of editor—and, let us say at once, has done this very creditably—the want of an author's final supervision is a severe injury to any work. Secondly, the author seems to have had to depend almost entirely on his own resources. In any but the very smallest district, it is nearly impossible for one man to know the whole of it, and this is quite impossible, even after a twenty years' residence, in a group of islands like the scene of Dr. Saxby's labours. He himself lived in the most northerly of those which are inhabited, and his connection by marriage with the influential family of Edmonston—which has produced so many gifted members—no doubt gave him unusual facilities for becoming acquainted with the peculiarities of Unst; but his professional duties in a great measure tethered him to one spot, and hindered him from carrying on his investigations in the more southern islands as he unquestionably would have liked to do. Thirdly, the author does not seem to have fully appreciated what the duties of a local naturalist in these days are. Twenty years ago even this book would have attained for him a very high rank among his brethren, but times have changed. So great is the advance in all branches of biology, that what then passed for the best of work is now far behind the age. The British ornithologist has become a more highly educated and better-read man than he was, and, what is more to the purpose, a man of wider views. He must not only know what are the general wants of his science at present, the problems which require solution, but, to take a good place, he must know also much more of what is being done by his neighbours than most of our forefathers in the pursuit cared to trouble themselves with. Lacking such knowledge as this, he is apt to miss the bearings of observations of the most interesting kind, and he is sure to be tediously minute upon matters which might or would have rejoiced his bird-fancying predecessors, but are of small moment to his contemporaries.

We do not write these words without pain. Every allowance must be made for the gentleman who secluded himself in the most northern of the British Islands, but many a man so placed would still have formed or kept up such an intercourse with the centres of thought and investigation as to enable him to be on a level, as to their results, with the best thinkers and investigators. Shetland, nowadays, in regard to communication, is hardly further removed from Edinburgh (or, for the matter of that, from London) than Selborne was in those of Gilbert White. Yet we find that White was in the front rank of the naturalists of his time, corresponding freely, frequently and on equal terms with the acknowledged heads of his vocation, testing by his own experience all that he learned from them, and, moreover, all that was known of the labours of foreign naturalists. *Maximis haud impar*, he criticised alike Linnæus, Scopoli and Kramer, Ray, Derham and Stillingfleet; and his criticisms are still defensible. Now, there is no evidence that Dr. Saxby did anything of this kind—an examination of his book gives no intimation that he was at all aware of what subjects were moving his brother ornithologists, whether at home or abroad. Most of his observations as they were made were transmitted for publication to a periodical which has been the delight of bird's-nesting and moth-pinning schoolboys, but, except in encouraging a taste for natural history among amateurs, it has been remarkable for persistently checking its scientific study. We do not of course blame Dr. Saxby for not occupying himself with species-splitting, nomenclature and such like refinements. They are only to be indulged in with profit by such as have ready access to museums and libraries, and are possibly not worth half the trouble that is taken about them by men who enjoy those facilities. But there were numberless subjects which were within his grasp, and yet are entirely overlooked by him. We may instance the many contested points as to the assumption of certain plumages by certain sea-fowls. A keen observer so favourably situated as Dr. Saxby, one would think, would have thrown some light on such questions. One of them relates to the various garb in which the bird, commonly known as Richardson's Skua, presents itself. The species is abundant, as everyone knows, in the Shetland seas; but not a word is vouchsafed to bring us nearer to an understanding of the matter. We are told, indeed, that parti-coloured birds and whole-coloured birds can be distinguished from the time that they are in the nest; but that much some of us knew before, either from our own experience or the testimony of others. Puzzles too, which, though perhaps

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* Germany is of course the only one which can compare with Britain in this respect; and leaving out of consideration the difference in extent of the two countries, there can be little doubt as to the side on which the numerical superiority lies. It is true that in Prof. Giebel's "Thesaurus Ornithologiæ" the titles of British works occupy barely *six* pages against *nine-and-a-half* of German. But the latter are really collected with much amount of care, while the former, if not taken at haphazard, have been picked on some principle of artificial selection which defies inquiry. Had the British journals been examined by that learned compiler at all as closely as the German, the list of papers relating to the ornithology of the United Kingdom would have been more than doubled.

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seldom discussed in public, have often been debated when two or three ornithologists are gathered together, are equally left without a word, while a word from Dr. Saxby would have been of the greatest value. Among such is that of the growth of the Puffin's monstrous bill. We have a very well told tale of the author's visit to a Puffin-warren on Hermaness, but it is just such an one as anybody not a naturalist would write, and contains nothing that dozens or scores of British ornithologists did not know before. Again, we may instance the migration of birds. An observer in such a look-out station as the extreme north of Shetland might, one would think, have furnished an infinite number of facts bearing on this important and perplexing question. Dr. Saxby contents himself with telling us when certain species come and go—very valuable information, no doubt, from so competent an authority; but as to the application of such facts, the impression they made as a whole upon his mind, their relation to similar observations in other places, not a word, so far as we can find, is said. Some of the Shetland migrants, we happen from other sources to know, touch the islands as their extreme western, others as their extreme eastern, limit; but this is all one to our author, who does not seem to care whence the wanderers come or whither they go; they are regarded by him as "the wind that bloweth where it listeth."

But enough of this unpleasing task. With the most sincere regret for Dr. Saxby's misfortunes and untimely fate, and a heartfelt sympathy with those who have to mourn his loss, we are compelled to say so much. The old adage *de mortuis* is very well in its way, but when we have him termed by reviewers "one of the first of our ornithologists," his book "a most valuable contribution to the ornithology of Great Britain," and all the rest of it, we must, if we speak at all, speak the truth. We could count at least a score of British ornithologists who, had their lot been cast in the Shetland Islands, would probably have done much better, and would certainly not have been contented to do so little. His intellectual and scientific capacity is reflected in his editor, who sees in the conductor of a popular magazine one "who has for so many years sat at the focal point" of ornithology—a metaphorical expression to which many meanings might be attached, one of which (though obviously not that of the writer) is that a focus may be found on a blank surface which receives rays of light and does not return them. The "Birds of Shetland" is a book of fair mediocrity. The next faunist, whose work we may be called on to review, will, we hope, take warning by its deficiencies, though for truthful observation—strictly limited, we must say, to observation—he cannot have a better model than Dr. Saxby. More, however, is expected of a faunist in these days.

MARSH'S "MAN AND NATURE"

The Earth as Modified by Human Action. A new edition of "Man and Nature." By George P. Marsh. (Sampson Low and Co., 1874)

AMONG the varied forms of energy by which the ceaseless changes of the earth's surface are produced—subterranean heat, air, rain, frosts, rivers, glaciers, the sea, and the rest—the geologist requires to include as a not unimportant agent, Life, both vegetable and animal. Some of the ways in which plants act in augmenting or retarding the operation of the inorganic forces are familiar enough. How often, for instance, do we see the walls of a ruin which have been split or cast down by the growing roots of some sapling tree which has found a footing in their masonry. The frosts and storms of winter would have levelled the walls in the end, but their action has been anticipated by the tree. Again, as an everyday example of the opposite kind of action, we may take the way in which the matted roots of trees which grow along the alluvial margin of a river serve to bind the loose sands or clays of the bank together, and retard the wasting effects of the current. Animals, too, have their own ways of effecting similar results, as every observant rambler in the country can testify. Moles, rabbits, and other burrowing animals lay bare the soil to rain and rivulet, and where they carry on their operations in loose materials liable to be dispersed by wind, as for instance on the sand-dunes by the sea, they may lead to the destruction of much valuable land under the drifting sand which they have uncovered. If we travel into other parts of the globe we find other and better examples, as in the dams of the beaver and the reefs of the coral-polyps. Less easily definable, but probably far more important, are the influences of life upon climate; for although the distribution of the fauna and flora of any region is in great measure regulated by climate, it is no less true that climate is modified by the flora, as is shown by the desiccation of countries which, once green and fertile, have been stripped of their woods.

So long as man remained in the savage state his influence resembled, and in some respects fell short of, that of the terrestrial animals who were his contemporaries. He felled a tree here and there, and when he had learned the use of grain, turned moorland into rude fields for culture. But his warfare lay not with the inanimate surface, but mainly with the beasts, fowls, and fish on which he chiefly depended for food and clothing. With the slow development of civilisation his influence as a geological agent has steadily increased, until now it must be ranked in the first class of the forces by which the surface of the land is modified. The time is yet too short during which accurate registers have been kept to admit of any very precise determination of the amount, sometimes even of the nature, of the changes effected by human action. But enough has been recorded to justify the attempt to indicate at least the general tendency of man's operations, while at the same time tolerably definite information exists regarding the results of some of his interferences with the ordinary economy of nature. In some respects man's influence is antagonistic to nature's usual modes of working, but of course, viewed broadly, it cannot do more than alter the balance of forces, giving to some a greater and to others a less share of work than in a natural state would be accomplished by them.

Mr. Marsh's "Man and Nature," published eleven years ago, was the first attempt, at least in English, to take a general view of this subject from a wide basis of reading. A work of research and generalisation from the labours of others rather than of original observation, it called attention to a field of inquiry too little cultivated by geologists. In fact, to its influence we may with probability ascribe the greater prominence now given in treatises of Physical Geography and Geology to the geological aspects of man's position on the globe. A new edition shows that the efforts of the author have not been wholly unappreciated here by that general reading public, not of professed *savans*, but of educated, observing men, to whom they were addressed. He must be gratified also to find that as his materials were in large measure derived from the observations of foreign writers, his work has met with a special measure of notice and approval on the Continent. It is frequently cited by recent French and German authors in Physical Geography and Geology, and a special Italian edition of it has lately been published under the author's supervision.

Of a book which has now established its position it is not necessary to say anything by way of criticism. This new edition has been somewhat enlarged, but the same division of subjects is retained. The author, who, besides being familiar with the characteristics of large tracts of his own country, the United States, has travelled extensively in Europe, brings his work abreast of the most recent discoveries and conjectures. The extent of his reading, remarkable enough in the first edition, is evinced again in this new issue. He seems to have come across the most out-of-the-way blue-book of the most out-of-the-way kingdom, and it has yielded to him some apposite illustration or suggestive fact. And even though we may be disposed to admire more the wonderful industry of research than the judgment in the selection of evidence, we cannot read even the most doubtful bits of testimony cited and commented upon without being made to think about what we may perhaps have noticed ourselves but never really reflected upon before. And there could hardly be a greater merit in a book than this. As to the change of title in this new edition, we are inclined to think it a mistake, for two reasons. In the first place, it is not in itself so good a title as the first; and in the second, the changes in the present edition are not sufficient to warrant the dropping of the name by which the book is generally known. This, however, is a small matter, and will not, we hope, damage the progress of a treatise which certainly ought to be one of the standard works of reference in the library of every well-educated Englishman.

BRINKLEY'S ASTRONOMY

Brinkley's Astronomy. Revised and partly re-written, with additional chapters, by John William Stubbs, D.D., Fellow and Tutor of Trinity College, and Francis Brünnow, Ph.D., late Astronomer Royal of Ireland, and Professor of Astronomy in the University of Dublin. (London: Longmans and Co., 1874.)

DR. BRINKLEY'S treatise on elementary astronomy, of which this is a new and revised edition, has been for many years one of the recognised text-books provided for the use of Trinity College, Dublin. We believe, however, that it is a work comparatively little known out of Ireland, and probably many English astronomers were not aware of its existence till its reappearance, in a new dress, under the able guidance and direction of Dr. Stubbs and Dr. Brünnow, by whom the present edition is revised, enlarged, and partly re-written. Its popularity as a text-book will doubtless be no longer confined to the sister island; for this treatise, although elementary in its character, contains such clear and concise explanations of some of the principal problems in astronomy, that its intrinsic merit alone will probably find for it a place among the choice volumes of every astronomical student, and also on the shelves of every astronomical library. We do not say that this "Astronomy" is all that can be desired, nor will it obviate the necessity for the employment of a more elaborate work on practical astronomy where extreme accuracy is required in the reduction of observations; but it does on the whole explain the different problems in a clear and easy manner and in popular language, without sacrificing those details which are necessary for a proper elucidation of the different problems. We should, however, have been glad if a more detailed account had been given of some of the subjects treated upon, especially in the chapter describing the instruments usually employed in making astronomical observations. The methods of determining the instrumental adjustments are sufficiently explained, but it would be of great service to amateur astronomers if examples had been given of the complete reduction of both meridional and equatorial observations, a kind of information rarely to be found in detail in astronomical treatises.

The name of Dr. Brinkley involuntarily carries us back so far into the history of modern astronomy that a doubt existed in our mind, before opening the book, that an astronomical treatise originally prepared so many years ago, even by so distinguished an astronomer, must necessarily retain much of an antiquated character, either in arrangement or material. Thanks, however, to the great practical knowledge of Dr. Brinkley, and to the editorial labours of Dr. Stubbs and Dr. Brünnow, we find the science is represented as accurately as if the work had been published now for the first time. In the days of Dr. Brinkley, directors of observatories did not consider it their duty to reduce their observations with that completeness which we are now accustomed to see. It was not till the present Astronomer Royal, Sir George Airy, was appointed to the direction of the Royal Observatory that the numerous observations of the moon and planets made at Greenwich since 1750 were reduced upon one uniform system, and of sufficient accuracy to be made available for the correction of the elements of the lunar and planetary orbits. Under these circumstances, many of the principal astronomical constants were not sufficiently determined in the early part of the present century, especially of those relating to observing astronomy, to admit of the production of a practical handbook in so satisfactory a manner as at the present day; but in all that was essential for the proper comprehension of the general planetary and lunar motions, no one had greater qualifications for such a task than the learned Bishop of Cloyne, who had himself, in addition to other researches on refraction and parallax, investigated the value of the constant of aberration from observations made with the 8-ft. circle at the observatory of Trinity College.

This introductory treatise is founded on a series of annual lectures on astronomy delivered by Dr. Brinkley before the undergraduates of Trinity College during his occupation of the Andrews Chair of Astronomy in the University of Dublin At the request of the College

Board these lectures were afterwards published, and they have since formed an important portion of the course of study required for the College examinations. For some time it was universally felt that the book was not in keeping with the advanced state of astronomical science, and that a new and revised edition was necessary. For this purpose, the authorities of Trinity College, who naturally have a traditional respect for this treatise, were fortunate in securing so accomplished an editor as Dr. Stubbs, and the co-operation of so distinguished an astronomer as Dr. Brünnow.

Seekers after the romance and history of astronomy will find in this volume few facts recorded in this interesting branch of the science, which the editors have apparently rightly considered as forming no part of a college text-book, for "the student who has made himself so well acquainted with astronomy as to find its history interesting will easily procure for himself, from a variety of authors, all the information he can desire." There is also a very limited amount of description of the physical aspects of the larger planets. We rather regret this omission, although there may be reason for doing so, for we believe that the book would have been more generally attractive and useful had some of the results of the numerous modern observations of the physical features of Mars, Jupiter, and Saturn been given. This treatise contains, however, what is far more valuable in a text-book, and which is often slurred over in many popular astronomical works of much higher pretensions, clear and concise explanations, accompanied in many instances with the formulæ of reduction, of various astronomical subjects. Among them we may name the theories of refraction and parallax, the phenomena depending on a change of position on the earth's surface, the motions of the moon and planets in their orbits, eclipses of the sun and moon, the application of astronomy to navigation and geography, the figure of the earth, the masses of the sun and planets, &c. A very fair description of the construction and use of the transit instrument, mural circle, and equatorial is also given, sufficient in fact to enable a non-practised but intelligent observer to understand easily the necessary adjustments required in the use of these instruments. There is an omission, however, though we could scarcely expect to find it inserted, as the method is only adopted in a few of the principal observatories, but a notice of which we are inclined to think would have been acceptable to many, and would doubtless increase the value of the section on astronomical instruments. We refer to the method of automatic registration of transits on a chronograph, instead of recording them by the ordinary or "eye and ear" method. It is true that the usual manner of making a transit is sufficiently explained, but as the chronographic registration is now frequently adopted in the determination of the differences of terrestrial longitudes, as well as in the ordinary registration of transits, we shall always be glad to see a description of the chronograph in every treatise on practical astronomy.

Besides considerable alterations in the arrangement of the subjects and additions to the text made by Dr. Stubbs, Dr. Brünnow has contributed new chapters on the physical constitution of the sun and heavenly bodies, on discoveries made by means of the spectroscope, on the proper motions of the fixed stars, and on the general advance of stellar astronomy. We need not remark more on these chapters than that the great astronomical reputation of Dr. Brünnow is a sufficient guarantee of their accuracy, and to observe that the principal results of the recent researches are given in a concise form, which makes these chapters most interesting as well as valuable reading.

We have hitherto given to this excellent treatise an almost unqualified approval, but there are one or two points of no great moment which we should like to see corrected in a future edition. Nothing offends the eye of an astronomer more than to see in an astronomical text-book errors in the orthography of well-known proper names. We have detected a few of such errors which ought to have attracted the attention of the editors if not of the printer. "Flamstead" for *Flamsteed* might reasonably be passed over in silence; but when we see "Faumalhaut" printed for *Fomalhaut*, "Fourcault," more than once, for *Foucault*, "Leomis ' for *Loomis*, "Maskeline," more than once, for *Maskelyne*, we cannot avoid feeling a pang of regret that in an educational work on the science such inaccuracies should have been allowed to pass. Again, it is unfortunate that greater care was not taken to correct the distances and magnitudes of the members of the solar system, depending upon the recent alteration of the value of the solar parallax, especially as the new value of the sun's distance in miles is frequently given. The old value in miles for the velocity of light per second, 192,000, might also have been corrected for the same reason. On page 152, the value of the solar parallax determined from Foucault's experiment is 8″·86, *not* 8″·942, this latter value being sensibly the same as that determined finally by Mr. Stone from a comparison of the Greenwich observations of Mars at the opposition in 1862, with the corresponding observations made by Sir Thomas Maclear at the Cape and by Mr. Ellery at Williamstown, Australia.

Notwithstanding these few slight drawbacks, we do not hesitate to recommend this most excellent treatise, which is moderate in price, to all who are interested in astronomical observations and in the progress of astronomy.

OUR BOOK SHELF

A Peep at Mexico. By John Lewis Geiger, F.R.G.S. (London: Trübner and Co., 1874.)

Mr. Geiger's book is chiefly devoted to a description of the not well known country westward of the town of Mexico. The route of his journey was from Manzanillo, on the coast of the Pacific, *viâ* Colima, Zacoalco, Guadalajara, Guanajuato, and Querétaro, to the capital.

The book gives but a "peep" at Mexico, but it is a very agreeable one; for, not entirely relying on his pen to describe what he saw, the author photographed *en route*, and forty-five views illustrate his book. Although the people, their habitations, and their ways, are the principal topics on which Mr. Geiger writes, yet here and there he gives glimpses of the natural history of the country. For example, the first part of his journey from Manzanillo was along the Laguna de Cuyutlan, which runs parallel with the shore, separated from the ocean by only a narrow strip of land. "It is almost completely enclosed by mangrove jungle, which overruns the banks and creates numerous islets by its growth where the water is shallowest. . . . There is no variety in the vegetation; mangroves monopolise all available space." The stagnant waters he describes as covered with a brownish green slime, disturbed occasionally by an alligator.

"Some spots were literally crowded with numerous varieties of ducks and teal. . . . Their cackling would often alarm a company of huge white cranes, quietly congregated on a sandbank. . . .

"On the floating islands, proud storks and sedate melancholy herons were engaged in catching and consuming their breakfast, whilst every nook of the mangrove thickets, every shallow in the lake, every log of wood on the water, was tenanted by all manner of birds, including alike the busy wagtail, the grandfatherly pelican, and the stately flamingo. As we cut the placid waters, a brace of neat sand-pipers or a swift kingfisher, scared by the snort of the engine, would suddenly emerge from the margin of the channel, and, darting ahead, be again frightened into the air almost before they had settled.

"Soaring in graceful circles far overhead, a variety of hawks view the scene from aloft, ready to pounce upon whatever appears an easy prey; whilst thousands of dark-blue glittering swallows hurry from island to island, feeding plenteously on the myriads of insects that hover above the water."

The vegetation near Colima is thus described:—

"The trees are not large, but are so interwoven as to form impassable barriers, even apart from the bushes and shrubs that spring from every spot of vacant ground. Hundreds of creepers cling to every trunk, and twine round every branch, connecting by a thousand wiry threads, thickets, shrubs, and cacti—a massive bulwark of profuse vegetation, through which the axe alone can hew a way. The huge *Organo* cactus, with its tree-like stem, often 2 ft. in diameter, and 10 ft. to 15 ft. high, sends up its stiff, straight branches to a height of 30 ft. or 40 ft. from the ground, whilst the smaller species mingle in thousands with the shrubs and bushes nearer the earth. Wherever the creepers may have neglected trunk or bough, prolific parasites, gay alike with taper leaf and gorgeous blossom, hasten to perform their part in this fairy work of nature. The flowers have little scent, but their profusion of white, yellow, and red, blended with the countless shades of green, charm the eye with tints as various as they are magnificent."

Beyond the fact of mentioning lava near Colima, Mr. Geiger has made no attempt to give any geological information, and the principal physical feature noticed is that the country is much broken up by *barrancas*, narrow ravines, which sadly interfere with the making of straight roads. The book is full of interesting information about social life.

Les Roses:—Histoire; Culture; Description. Par Hippolyte Jamain et Eugène Forney; préface par Ch. Naudin. 60 chromolithographies d'après nature, par Grobon. 2^{me} edition. (Paris: J. Rothschild.)

LIKE so many of our garden-flowers, the history of most of our cultivated varieties of the rose is involved in obscurity. A few species, as *Rosa centifolia* (the Cabbage Rose), *gallica*, *damascena* (the Damask Rose), *moschata* (the Moss Rose), *lutea* (the Yellow Rose), have retained their distinguishing characters; but the majority of the florist's flowers are the result of hybridisation or variation, in which all trace of their nativity is lost. The same is the case also in Western Asia, the rose which yields the famous attar of roses being of very doubtful origin, probably a form of *R. damascena*. In the work before us we have a history of the cultivation of the rose, followed by a description of the various species and varieties, with their geographical distribution; an account of the various modes of cultivation; and a history of the diseases and insect enemies to which it is liable—all embellished with very beautifully executed woodcuts. The greater part of this handsome volume is occupied by sixty chromolithographs of well-known roses, which are triumphs of the engraver's art. The colours are so truthful, and the execution so clear and brilliant, that even in engravings coloured by hand you could scarcely obtain more accurate or beautiful illustrations. The volume is one that deserves a place on every drawing-room table.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Dr. Petermann's Letters to the Presidents of the Royal Geographical Society in 1865 and 1874

THE letter from Dr. Petermann to the President of the Royal Geographical Society, dated Nov. 7, 1874,[*] refers to what took place ten years ago, and to the two letters which he then addressed to Sir Roderick Murchison on the subject of arctic exploration, a subject on which he then, as now, assumed for himself the right of speaking as an authority. There are many geographers who feel very strongly that Dr. Petermann did great injury to the cause of arctic discovery in 1865, and it seems desirable that as he has again put himself forward as an authority, his pretensions to that character should be examined.

Captain (now Admiral) Sherard Osborn read an exhaustive paper before the Royal Geographical Society on Jan. 22, 1865, in which he advocated a renewal of arctic exploration by the route of Smith Sound. The long series of voyages in the direction of Spitzbergen had proved, by a process of induction, that the Smith Sound route was the one that should be followed; while the development, during the Franklin searches, of that system of sledge travelling with which the name of M'Clintock is associated, caused a revolution in the method of exploring, and must be looked upon in the light of a discovery. From that time it has been known that land must be the basis of polar exploration, that a real advance can only be made by following the land-ice, and that sending ships into the drifting packs between Greenland and Novaya Zemlya is a useless waste of time and money. Sir George Back, Admiral Collinson, Sir Leopold M'Clintock, Admiral Sherard Osborn, Captain Vesey Hamilton, and other arctic officers practically acquainted with the subject held that view in 1865, and they hold it now. Their opinions were based on practical experience and on the records of former voyages, and nothing has occurred since either to alter or to modify them.

Admiral Osborn's proposal was cordially supported, and there appeared to be good reason to expect that it would be unanimously accepted; when two letters from Dr. Petermann to Sir Roderick Murchison, by causing a useless and barren discussion, had the effect of destroying these fair prospects.

Dr. Petermann has no practical knowledge whatever of the arctic regions. He is famous for having propounded a theory more than twenty years ago, and he has ever since striven to make the obstinate facts fit into it—a hopeless task. So that while he has no actual acquaintance with the polar regions, the exigencies of his theory prevent him from judging of what he reads with an unbiassed mind. It was in January 1852 that the Petermann theory was first given to the world, in the form of a "Plan of Search for Sir John Franklin." The theory is that there is an open sea round the pole, caused by the Gulf Stream, and that it can be reached late in the autumn with perfect ease, by sailing north between Spitzbergen and Novaya Zemlya. He urged that Franklin's ships were beset near the coast of Siberia, and that the way to reach them was by sailing across the polar ocean during the winter.

This is the Petermann theory. It might have been very mischievous in 1852, by diverting the search from the proper direction; but fortunately it was considered absurd, and received little or no attention. Unluckily for the cause of arctic research, Dr. Petermann resuscitated his theory in a modified form, in his two letters to Sir Roderick Murchison, in which he advocated the Spitzbergen route in 1865.

Dr. Petermann assigned eight reasons for his preference, which are easily disposed of. His first reason was that the voyage from England to the North Pole is shorter by Spitzbergen; a matter which may be important to a company wishing to establish a line of packets between the two points, but which has no bearing on the question of exploration. His second reason was that the Spitzbergen seas 'form the widest openings into the unknown region. This is one of the strongest objections to the route, for the navigation must be conducted in a drifting pack, which is fatal to a successful advance. The third reason is still more remarkable, namely, that the "Spitzbergen seas are more free of ice than any other part of the arctic regions." This assertion is diametrically opposed to the experience of all who have visited those seas. The fourth reason is that "the drift ice north of Spitzbergen offers just as much or as little impediment to navigation as the ice of Baffin's Bay." This statement is made in the face of the fact that a fleet of whalers has annually passed through the ice of Baffin's Bay for the last fifty-six years, while the pack north of Spitzbergen has never once been penetrated. The fifth assertion is that "the sea north of Spitzbergen will never be entirely frozen over, not even in winter, nor covered with solid ice fit for sledge travelling." This is possibly true, and it forms another strong objection to the Spitzbergen route, for these streams and pools of water, while making exploration by sledges impossible, would add to the danger of wintering in the pack. The sixth assertion is that from Sir Edward Parry's furthest point a navigable sea was extending far to the north, and that in 82° 45′ there was a perfectly navigable sea. The assertion is the very reverse of the real fact. Parry, at his extreme point, found the ice thicker and the floes more extensive than any he had previously met with, and there was a strong yellow ice blink always overspreading the northern horizon, denoting field-ice. The seventh assertion is that "the polar region north of Spitzgergen consists of sea and not land." This is the very reason that the Spitzbergen route is the worst that can be selected, land and land-ice being essential to a real advance. The eighth and last reason is that Parry's voyage only took six months. Here is another reason against the example being followed, for a hasty voyage of that kind must fail to secure the scientific results to be obtained from arctic research.

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[*] Published in NATURE, vol. xi. p. 37.

So much for Dr. Petermann's first letter to Sir Roderick Murchison. The only point in the second letter is the argument that there will be no difficulty in boring through the polar ice-fields north of 80°, because Sir James Ross got through the extensive pack in the antarctic regions in lat. 62° S., after it had drifted and become loose for many hundreds of miles over a boundless ocean. The fallacy of this comparison was fully exposed by Admiral Collinson.* That arctic explorer pointed out that the antarctic pack was drifting away from a solid line of immovable grounded ice-cliffs, and of course left open water in its rear, because there was no moving ice further south to take its place. The exact analogy of the voyage of Sir James Ross in the south is that of Scoresby in the north. The antarctic pack, in lat. 75° S., is analogous to the ice met by the whalers in the early spring in 75° to 76° N., through which they can usually pass. The open water north of Spitzbergen is analogous to the open sea found by Ross in the south; and the polar pack which Scoresby found bounding that open water to the north, from whence the ice he had passed through had drifted, is analogous to Ross's line of impenetrable ice barrier.

Dr. Petermann finally asked for any reason, however slight, why it would not be as easy to sail from Spitzbergen to the pole *and back* as to go up Baffin's Bay to the entrance of Smith Sound. This is a curious instance of the way a preconceived theory destroys the power of seeing the simplest facts. The reason is clear enough, and is well known to all arctic navigators. North of Spitzbergen the sea is encumbered by a drifting pack, through which no ship has ever penetrated. In Baffin's Bay there is land-ice, along which vessels can creep while the pack drifts past. The consequence is, that whereas a fleet of whalers passes up Baffin's Bay every year, no vessel has ever gone far into the pack north of Spitzbergen.

Although these fallacies were completely exposed at the time, the letters containing them caused a barren discussion which gave the appearance of dissension among geographers, and destroyed the previously hopeful prospect of the English Government being induced to consider Capt. Osborn's proposal favourably. Unanimity was essential to success; and thus Dr. Petermann's inopportune letters had the effect of throwing back arctic discovery for ten years.

At the same time the efforts of Capt. Osborn and his fellow arctic voyagers in 1865 bore some good fruit. His own paper is an important document, which clearly states the true principles of arctic exploration, and has been invaluable for reference. Dr. Hooker prepared a statement of some of the scientific results of an arctic expedition; and Commodore Jansen, of the Dutch Navy, contributed an admirable memoir on the discoveries and proceedings of his countrymen in the Spitzbergen seas.

Having thus seriously injured and retarded the progress of discovery, so far as England was concerned, Dr. Petermann called upon his own countrymen, with some success, to undertake arctic voyages in pursuit of his theory. Two or three such voyages were undertaken. In 1868 the *Germania* made a voyage to Spitzbergen with exactly the same result as had attended the hundreds of voyages which preceded it; and in 1869 another *Germania* followed the track of Capt. Clavering in 1823 to the Pendulum Island, on the east coast of Greenland, adding nothing whatever, so far as navigation is concerned, to our previous knowledge. Capt. Koldewey commanded both these expeditions, and he returned after being fully convinced of the fallacy of Dr. Petermann's theory, and that Smith Sound is the route for effective north polar exploration. It is much to be deplored that these gallant German explorers, who certainly might have done really good work if they had been guided by the practical experience of their predecessors in arctic navigation, should have been made to waste their energies in accordance with a fanciful and baseless theory.

The other arctic work that has been achieved since 1865 was not undertaken under Dr. Petermann's auspices, or to prove his theories; and the results have been much more important. The Swedes have done admirable scientific work in Spitzbergen. The Norwegians. under the auspices of Prof. Mohn, of Christiania, have circumnavigated Spitzbergen and Novaya Zemlya, and revisited Wyche's Island in 79° N., which was discovered by an English ship in 1617. Capt. Hall sailed far up Smith Sound, proving the accuracy of Admiral Osborn's views; and lastly, Lieut. Payer and Capt. Weyprecht discovered the extensive region between Spitzbergen and Novaya Zemlya, and proved the utter fallacy of Dr. Petermann's theory, which he propounded in 1852, and has since so persistently adhered to. The ice drifted with the wind, and there was no sign either of a warm current or of a navigable polar basin.

In 1872 Admiral Sherard Osborn read his second paper, again urging the renewal by England of arctic exploration by the route of Smith Sound, with the west coast of Greenland as a base. Fortunately, complete unanimity was secured, and, thanks to the tact, judgment, and perseverance of two successive Presidents of the Geographical Society—Sir Bartle Frere and Sir Henry Rawlinson—the Government has resolved to fit out a naval arctic expedition of discovery to proceed by way of Smith Sound. Success has thus at length crowned the efforts of the Society, and baseless theories have had to give place to the experience of practical men.

Yet we have been again visited by a long letter from Dr. Petermann, which, however, did not arrive until the question was settled. Its precise object is, therefore, not very apparent; but, remembering the injury done by the two previous letters in 1865, it is certainly incumbent on those who have, after much labour and watchfulness, reached the goal, to defend the ground which has been gained, even when the old opponent has become apparently harmless.

In his third letter Dr. Petermann begins by the assertion that actual exploration since 1865 has proved that there is "greater navigability in all parts of the arctic seas than was formerly supposed to exist." There is really no ground for this assertion. Our knowledge of the arctic seas previous to 1865 has not been increased to any material extent, and the amount of navigability in those seas was as well known before that date as it has become since. The voyage of Capt. Hall, satisfactory as it is, merely proved that practical arctic men were right, and that the theorists were wrong; and although it is very generous of Dr. Petermann to withdraw his opposition to the Smith Sound route, he must surely be aware that the time has now passed when that opposition would have any effect. If the voyages since 1865 have not added much to previous knowledge, they have at least had the effect of disproving a theory which has done more than anything else to retard discovery.

Most of Dr. Petermann's letter consists of a recapitulation of the work accomplished by the Norwegians on the coast of Novaya Zemlya, and by other recent voyagers, the point of which is not apparent; and of an attempt to make out that Payer and Weyprecht were not the discoverers of Franz-Joseph

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* Royal Geographical Society's Proceedings, ix., p. 118.

Land, but that it was visited previously by Baffin and by Cornelis Roule. His arguments are not at all borne out by the authorities to which he refers. Nor will the British Government be guided by any proposals not originating from those experienced arctic officers upon whose advice they rely, so that Dr. Petermann's suggestions about sending one steamer to the west coast and another to the east coast of Greenland might have been spared.

English geographers have always fully recognised the valuable services of Dr. Petermann as a cartographer, and the important and useful work he has long done in collecting and disseminating geographical information. But at the same time it cannot be forgotten that his persistent adherence to an indefensible theory has retarded discovery, and that in 1865 his inopportune interference had a most injurious effect upon the prospects of arctic exploration from this country. That danger is at last overcome, but those who have borne the heat and burden of the day, cannot but protest against Dr. Petermann's present assumption of the position of an arctic authority and adviser.

Nov. 22 CLEMENTS R. MARKHAM

The Present State of the Arctic Ice Barriers

IN a letter from Capt. David Gray, quoted by Dr. Petermann (NATURE, vol. xi. p. 39), some very interesting observations on the arctic drift ice of this year's summer are recorded, which Capt. Gray regards as justifying the conclusion that "nearly the whole of the ice was driven out of the arctic basin last summer."

Capt. Gray's observations appear to be limited to the coast of Greenland. If corresponding phenomena were presented in other and distant parts of the Arctic Ocean, they must afford strong confirmation of his conclusion. I have lately returned from a summer visit to Arctic Norway, having sailed round the North Cape and into the Varanger Fjord, stopping a few days at Tromsö and halting at Hammerfest, Vardo, Vadsö, and other arctic stations, and I was much surprised at the curious difference between the climate I found there this summer and that which I previously experienced at the same season.

The following extract describes the temperature between Tromsö and Hammerfest during my first visit in July 1856:—"The weather was excessively hot. During the hottest part of the day the thermometer stood at 77° in the cabin, at 92° in the smoking saloon—a little cabin built on deck—and 108° in the sun: on shore, in the valleys, it must doubtless have been much hotter. The contrast of this glaring Italian, or I might almost say Brazilian sky, with the snow-clad rocks and glaciers dipping almost to the sea-edge, is very striking. It was a continual source of wonderment; one of the few scenes which one does not become accustomed to, but retains its novelty day after day."* Such was the prevailing weather during the summer of 1856, and such is the usual summer weather of Arctic Norway from the beginning of July until a week or two after the disappearance of the midnight sun. This year it was miserably different, to the great disappointment of the ladies I ventured to pilot thus far, and vexation to myself. The contrast was strikingly shown in the course of a walk up the Tromsödal. This summer I made two excursions up this valley with a fortnight's interval. On both occasions the lower part of the valley was a mud swamp from recent snow-thaw. In 1856, three weeks earlier in the season han my second visit this year, the snow water had evaporated, leaving the path hard and dry. In 1856, the poor little Lapps were outside their huts, gasping with heat and varnished with oily perspiration; their huts were so insufferably hot that only one or two out of a party of seven or eight male travellers dared to venture inside. This year, the ladies, as well as myself, were glad to warm ourselves by sitting round the hut fire upon the boulders that serve as chairs. Drizzling rain and cold mists replaced the oppressive heat, the brilliant sky, and rainless summer-time of 1856.

The Duke of Roxburgh, who has spent sixteen summers in Arctic Norway (he has the Alten salmon river opening in lat. 70°), told me that the low temperature and drizzling mistiness of this summer was quite exceptional to his experience; that the summer of 1868, which was memorably cold, was not so bad as this. The usual crops of rye and potatoes were expected to fail completely this summer.

This unusual summer is the more remarkable when compared with that of England, which, judging by the abundance of the wheat crop, must at least have reached, if not exceeded, the average of mean warmth. The exceptional arctic summer must have been due to some exceptional arctic influence. The southward drifting of large quantities of polar ice, and consequent removal of some of the barriers that stand between us and the north pole, will account for what I have described, provided the loosened ice was sufficient in quantity and eastward extension.

The North Cape, though in lat. 71°, is not visited by icebergs; the sea there, and for some distance further north, is sufficiently warmed by the Gulf Stream to remain quite open all the year through. The free northward exposure must, however, render this part of the Arctic Ocean very susceptible to the cooling influence of an unusual southward drift of polar ice, and the peculiarities of this year's summer were exactly those which such an abnormal cooling of the sea would produce. These were evidently exaggerated over the open sea a little further north. During the few fine days we had while going round the island of Magerö, the sun was visible until about 11 or 11.30 P.M., but on approaching the north horizon it dipped into a mist-bank which hung with apparent permanency over the northernmost and most distant part of the sea. As we were desirous of seeing the actual orb of the sun quite at midnight, this repeated disappearance just at the critical time was of course especially noted. I afterwards learned that on these same nights, when the midnight sun thus played at hide-and-seek with us over the Arctic Ocean, it was clearly seen by spectators further south, who had a land or near coast horizon.

These facts, in conjunction with "the important information" given by Capt. Gray, justify us, I think, in looking forward very hopefully for important results from the proposed Arctic Expedition, and afford strong reasons for avoiding any possible source of delay that might stand in the way of an early start to make full use of next summer.

W. MATTIEU WILLIAMS

Zoological Gardens, Regent's Park

I MUST trouble you with a few words in reply to your correspondents "Viator" and Mr. C. Traill (vol. xi. p. 67.)

It is quite true that our gardens in the Regent's Park are "*too small in area.*" We have for many years endeavoured to get them enlarged; but all we have succeeded in obtaining is the slip of land on the north side of the Regent's Canal, where the new North Entrance has been made. If "Viator" has any influence with the First Commissioner of Works, and can persuade him to grant us a further extension on the south side, we shall be truly grateful.

I admit also that the larger carnivora are at present badly housed, and that their dens are much too confined. This, however, will, I trust, be remedied by the erection of the new Lions' House, which will be commenced early next year.

The plan of establishing a second Garden for breeding purposes out of London was adopted by the Council some years ago, but was not found to answer. It has, however, many advantages, and may be again tried when our funds shall permit of it.

"Viator" finds great fault with our drainage. He cannot be aware that the Sanitary Authorities of the district, who have been much exercised in this matter, have pronounced us free from all blame.

Finally, I may say, without any wish to disparage the continental gardens (with all of which I am well acquainted), that none of them can vie with those of this Society in the extent, variety, and completeness of its living collection, or in the rarity of many of the objects exhibited. That this collection is appreciated by the public is fully evident from the yearly increasing number of visitors and the continual augmentation of the list of members.

As regards the remarks of Mr. Traill, I have to observe that the Society's "Proceedings" contain several papers by the Secretaries and Superintendents of the Gardens relating to points in the economy of the animals in them; and that the Prosector (whose office was created mainly with the hope of utilising the collection more completely in a scientific point of view) has lately devoted considerable attention to this subject, on which he will, no doubt, ultimately give us the benefit of his observations.

Dec. 1 P. L. SCLATER

Utilisation of Aquaria

I SHALL be glad if you will allow me to use your columns as a medium of inquiry with regard to the Brighton and Manchester Aquaria. Are there any arrangements in force already, or contemplated, whereby these fine institutions can be utilised for the promotion of zoological research? If I am not mistaken, the

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* "Through Norway with a Knapsack," p. 139.

British Association, at its meeting at Bradford, appointed a committee, the function of which was to see what arrangements of this nature could be carried out. I am not aware, however, that the committee has ever made any report, or if it has arrived at any conclusion on this subject. INQUIRER

Nov. 24

Discovery of Remains of Plants and Insects

I THINK I informed you about two years ago of the discovery of a bed of plants, with leaves, and a great variety of seeds, in this locality; also the wings of a Libellula, and the beak of a bird. As little interest was attracted, I have not hitherto informed you of the subsequent finding of a bed of insects—flies, gnats, and the larva and pupa of the latter, the larva in countless thousands—also the wings, in great numbers, of a variety of flies, butterflies, and one or two grasshoppers; also a wing resembling that of the Mole Cricket. There are, likewise, two or three beetles. The insects and wings are frequently associated with a very pretty Lymnea, in considerable numbers, and an occasional Planorbis, both retaining a high polish. I have also noticed a solitary small white Cyclostoma in the same bed. There are, I think, two feathers among the specimens obtained. Perhaps, as some interest has been shown in a similar discovery in Scotland, some of your readers may like to be informed of this. I am much indebted to the Rev. T. G. Bonney, of St. John's College, Cambridge, to whom you referred me, for advice and encouragement in examining these beds.

Gurnet Bay, Nov. 23 E. J. A'COURT SMITH

Sounding and Sensitive Flames

IN a letter which I have just received from Dr. A. K. Irvine, of Glasgow, my attention is drawn to a short abstract of some of his experiments with Barry's sensitive flame, which appeared in the *English Mechanic* of Dec. 15, 1871, a few months previously to the appearance in the *Journal of the Franklin Institute*, and in the *American Journal of Science*, of the description, referred to briefly in my last letter (NATURE, vol. xi. pp. 6 to 8), of Mr. Geyer's researches on the acoustic properties of the same flame, some particulars of which Dr. Irvine appears also to have noticed independently. The few lines in which his observations are recorded corroborate so fully the character and mode of action of the flame as now pretty perfectly established, that a short extract from them will scarcely be without interest, from the satisfactory support which it offers to the accounts and explanations that other investigators of this flame have elsewhere given in graphic terms of its appearance.

After noticing that it can be produced with an ordinary street-lamp burner (perhaps the straight quill-form, still to be met with in some streets of Glasgow, is here meant), as well as with pin-hole jets of steatite; and that whatever kind of gauze may, with slight differences of the effect, be used, the further the wire-gauze can be removed from the burner without the flame breaking or flattening (? fluttering) on the gauze, the more sensitive is the flame,—Dr. Irvine continues to describe the further characters of the flame as follows:—

"4. The roaring which takes place when any sound disturbs the flame is evidently in consequence of the greater proportion of air which mixes with the gas before passing through the wire-gauze; in short, when it roars and flattens on the gauze, it is an explosive mixture that burns.

"5. If a suitable tube (for instance, a paraffin lamp chimney of proper dimensions) is placed on the wire-gauze, it will be found that a musical note is produced every time the flame is disturbed by a sound with which it sympathises.

"6. A mixture of any inflammable gas and air passing through wire-gauze, over which a suitable chimney is placed, will give a note varying in pitch with the dimensions of the chimney and size of the flame."

Proceeding on this principle, Dr. Irvine adds that he had recently constructed and patented a form of miner's safety-lamp, which, when an explosive mixture of gas and air enters it, gives an audible signal of the dangerous condition of the mine.

It may be questioned if it is quite safe to excite rapid vibrations of a gas-flame burning on the wire-gauze inside a safety-lamp placed in an explosive atmosphere; but if any vibrations of the flame that are thus produced are limited (as it appears possible to ensure, by a proper construction of the lamp) to the extremely small oscillations of a high-pitched note, then no elements of danger in this new contrivance need necessarily be introduced or apprehended from the sounding action of the flame. In this and in other cases of their employment which have suggested themselves to experimenters on the acoustic properties of gas-flames, there seem to be hopeful promises of advantageous application of the sensitive and sounding properties that certain gas-flames possess in a very high degree. But it is to the explanation of the cause of the prostration, and to the account of the case of musical sensitiveness in Barry's wire-gauze flame when disturbed by external sounds, that it is particularly desired to direct attention in the foregoing extract from Dr. Irvine's brief description. The reason that the author assigns to them, and thence to the monitory action of his singing safety-lamp, that increased inflammability of the burning gas-mixture is at once the source of the sensitiveness, silent or sounding, of the wire-gauze flame, and the necessary condition of the atmosphere for the alarm note sounded by the newly invented safety-lamp, is so clearly expressed and illustrated by the order of his experiments, that as regards the probable mode of action of the disturbed gas-current adopted to explain the sensitive effects observed, there can be no doubt of the correctness of Dr. Irvine's view.

The gas-current, before reaching the wire-gauze, will naturally entangle and mix with a larger quantity of air when it is disturbed, by presenting a greater surface to the air in that state than when it issues smoothly. In the latter case it is not inflected into the tortuous wave-line of many folds and curves into which it must be bent on leaving the burner and passing from a fixed jet into an atmosphere oscillating rapidly to and fro under the action of external sounds. The sound-wave of the air into which it flows thus serves to incorporate more air with the upward stream and to render the combustion of the mixture more condensed and prompt, and the appearance of the flame in consequence more contracted and boisterous than when the gas-jet burns in a surrounding atmosphere of quiescent air.

Newcastle-on-Tyne, Nov. 14 A. S. HERSCHEL

SCIENCE IN MUSIC

AT the first meeting of the Royal Society on Thursday evening, the 19th ult., a paper was read by Mr. A. J. Ellis, F.R.S., on "Musical Duodenes." This formed the conclusion of a series of papers (the preceding ones having been published in the Minutes of Proceedings) on Just Intonation and Temperament in Music.

The author explained the defects of the ordinary keyed instruments, such as the pianoforte and organ, which were limited to twelve sounds in the octave, and were now tuned by a system which he characterised as the "worst possible," every element of harmony in them being put out of tune in all keys. To produce just intonation, it was necessary to have many more than twelve sounds in the octave; and he exhibited a chart giving a classified list of seventy-eight such notes, distinguished by the ordinary musical signs, with the addition of certain other marks which defined exactly the pitch of the notes, while their respective positions in the chart gave, by simple inspection, a correct idea of their relations to each other. Mr. Ellis then stated that as the large number of notes required by correct theory became troublesome in practice, the plan had been adopted of sacrificing absolute truth in some instances, and introducing a trifling error, by which means the requisite number of notes was much reduced, while the error was so small as not to offend the ear in any sensible degree.

Having determined thus on the number of notes to be used, the practical problem arose how best to introduce them in an instrument. Many contrivances had been suggested, involving new key-boards and modes of fingering; but considering the difficulty of introducing changes of this kind, preference was given to other plans, which retained the twelve notes of the ordinary key-board. To enable such a system to be carried out, it was necessary to make choice of certain *sets* of twelve notes, to be used when playing in certain keys; and to furnish information to guide these selections was the chief object of the paper. Such a set of twelve notes was called by Mr. Ellis a musical *duodene*, and the chart exhibited many of these combinations, the properties of which and their appropriateness for particular cases were easily ascertainable.

Mr. Ellis, while deprecating the introduction generally of musical performances under the guise of lectures, illustrated his propositions by showing the effect of several instruments of fixed tones, concertinas and harmoniums, tuned in different ways. Some short harmonical passages were played, first on a harmonium of the ordinary kind, secondly on another with absolutely just intonation, and thirdly on a newly-constructed harmonium tuned on Handel's plan of the old organ temperament, but with the addition of several other notes enabling music to be played in all keys, equally well in tune. These additional notes were brought into use by draw-stops, each of which made an enharmonic change in one note, as from C sharp to D flat, G sharp to A flat, and so on. The stops were arranged before commencing the piece according to the key it was in, and they could be instantly altered at any time during its progress, if required by modulation. In this instrument the major thirds (the intervals to which the ear is most sensitive) were all justly in tune, but the fifths and minor thirds were a little flat; the ear, however, tolerated these slight errors much better than the extremely discordant error of the major third in equal temperament, and the effect of the harmony as played upon it was a great improvement on that plan.

Mr. Ellis, in the course of the paper, made frequent mention of the views of Helmholtz on harmony and temperament, and illustrated them by examples.

After the reading of the paper, Dr. Pole, F.R.S., remarked that Mr. Ellis's method of treating the elements of the musical scale had much originality, and had an interesting bearing on the structure of harmony generally; its principal object appeared, however, to be, in continuation of the author's former labours, to facilitate the production of correct intonation in music, an object of much importance. He would remind the meeting what was the present state of matters in regard to this. The fact was, that at present it was but seldom possible to hear what true harmony was like, as the great majority of music-producing instruments, namely, all those with fixed tones, were deliberately and systematically tuned false, with an amount of error painful to a sensitive ear. When he, a day or two ago, put his fingers on Mr. Ellis's just harmonium, he uttered an involuntary exclamation of surprise, for he had not heard the true harmony of a common chord for some time before. The public had only two opportunities of hearing true harmony: one when a stringed quartett was played by fine players; the other when a vocal unaccompanied piece was sung by first-rate singers. In each of these, the performers, being untrammelled by the odious temperament, gave way to the dictates of their correct ears, and produced true harmony. Every person of musical taste knew well the delightful impression produced by this kind of music. In modern oratorios it was very customary to insert, as in "Elijah," for example, an unaccompanied vocal piece, which was always rapturously applauded. Yet few people thought of the cause; it was not the composition, for the same music, when played on tempered instruments, was quite another thing; it was not even the skill of the performers, which could be manifested in other ways; it was purely and simply the fact of the harmonies being in tune, which was an agreeable novelty to the ear.

On the pianoforte, where the sounds were not long sustained, the errors of the temperament were not so offensive, but on instruments with sustained tones, such as the organ and harmonium, the defects were much more prominent. In olden times musicians had more sensitive ears, and organs were tuned (as Mr. Ellis had stated in regard to Handel's organ) on a temperament which put the principal keys in good tune, and threw the defects into keys seldom or never used on an organ in those days. But since that time, as modern music, and especially what the Germans called *Fingerfertigkeit*, had increased in popular favour, organists had made up their minds to play in all sorts of remote keys, and had demanded that the organ builders should favour this by applying the equal temperament. For show organs this course might be defended, but for church organs, where nothing was required but the use of the simplest keys, it was perfectly indefensible, as it was spoiling the tone of the organ for its ordinary use, for the sake of a purely imaginary want. The organ was half a century ago a sweet-sounding instrument; now it was a harsh, offensive one, which made attendance at church a penance to persons with musically sensitive ears. A curious proof occurred a few years ago as to the mischief the equal temperament did to the tone of an organ. Dr. Pole had to superintend the construction of two organs of tolerable size: in one he was obliged to give way to popular prejudice by having it tuned equally; in the other he pleased himself by adopting the old tuning; and although the instruments were precisely alike in other respects, and made by the same builder, the latter acquired the reputation of a peculiarly sweet-toned organ, while the former was considered a harsh tone.

It was time something was done to correct the evil, but there had been difficulties both theoretical and practical. Theoretically it had been difficult to determine what should be the exact pitch and number of the notes to be used, but he conceived Mr. Ellis had now exhausted that subject, and that for the future no person who wished to carry out plans of just intonation would find difficulty in selecting from Mr. Ellis's data, exactly such *duodenes*, or series of notes, as would answer his purpose. There were still difficulties in practice, for as it was certain that more notes than twelve must be used, the problem how to enable the player to arrange them easily was not an easy one. In this particular, however, progress was being made; Mr. Ellis had pointed out several important simplifications, and Dr. Pole especially looked on the harmonium with shifting tones now exhibited as a promising invention. It was pleasant to hope there was some practical possibility of getting music in tune.

The continued discussion of the subject of just intonation was very desirable, for the reason that practical musicians, probably from a feeling of hopelessness as to getting anything better, were beginning to consider equal temperament as a necessary evil, and to look upon its harshness with indifference. Indeed, it was to be feared that the ears of musicians were becoming actually deteriorated in sensitiveness to errors of intonation. In our best orchestras, for example, although the strings might play in tune (for our orchestral violinists had no superiors in the world), yet the wind instruments were often false; and our conductors, even the best of them, seemed callous to the cacophony. He might remark here that the efforts at producing just intonation had been hitherto confined to instruments with the pianoforte keyboard, but there was a wide field open for the improvement in this respect of orchestral wind instruments, in regard to the just intonation of which absolutely nothing had yet been done. The utmost wind instrument makers had aimed at was to make them play correctly on equal temperament; he was not aware that anybody had thought it worth while to make enharmonic distinctions in their scale.

On all these accounts Mr. Ellis's labours to improve the general knowledge of the subject were most valuable, and earned for him the gratitude of all true lovers of music.

THE TREE-ALOES OF SOUTH AFRICA

THE flora of Southern Africa is extremely remarkable, not merely for the number of its species and their generally very restricted range, but also for the frequent singularity of their aspect and manner of growth. In each of these particulars the genus *Aloe* is no exception to the general rule. Many of the species are well known in cultivation, but all agree in having fleshy elongated evergreen leaves, and thick erect spikes of yellow or red flowers. Medicinally, many species (and possibly all might be) are of importance as yielding a well-known bitter drug; which is simply the juice exuded from the leaves when cut, and boiled down to a solid consistence.

The species of *Aloe* are probably only really indigenous in Southern and Eastern Africa. *A. vulgaris* is now, however, found widely distributed along the Mediterranean and in the East and West Indies, where it is cultivated as the source of the Barbados and Curaçoa aloes.* *A. indica*, Royle, is doubtless a slight variety. Dr. Stewart mentions it as being occasionally cultivated throughout the Punjâb, and says that the pulp of the leaves is eaten by poor people and in famines.† According to the same writer, the Aloe mentioned by Masson in the Punjâb is a palm (*Chamærops Ritchiana*).‡ *A. littoralis*, König, found at Cape Comorin, is believed to be a form of *A. vulgaris*, altered by the circumstances of its situation. The habit of growth in the genus varies considerably. Mrs. Barber, a well-known South African naturalist, gives the following account of the part they play in the physiognomy of the native vegetation:—

"The genus *Aloe*, Linn., has a wide range in this country, its numerous species occurring in all rocky localities throughout the land; wherever rocks are found there are the Aloes also, cropping out (if I may be allowed the expression) with the geological formations of the country, as if they formed a part of them, decorating each knoll and cliff with their gay blossoms in great profusion and variety, from the gigantic Aloe of the Transkeian territory, which attains the height of sixty feet, and the tall, graceful, wood Aloes, to the sturdy, stout-built Aloe of the cliff, and the minute lizard-tail-like species that are scattered among the grass, each filling its peculiar *locale* to complete the character of the landscape, and to render it truly South African in appearance."§

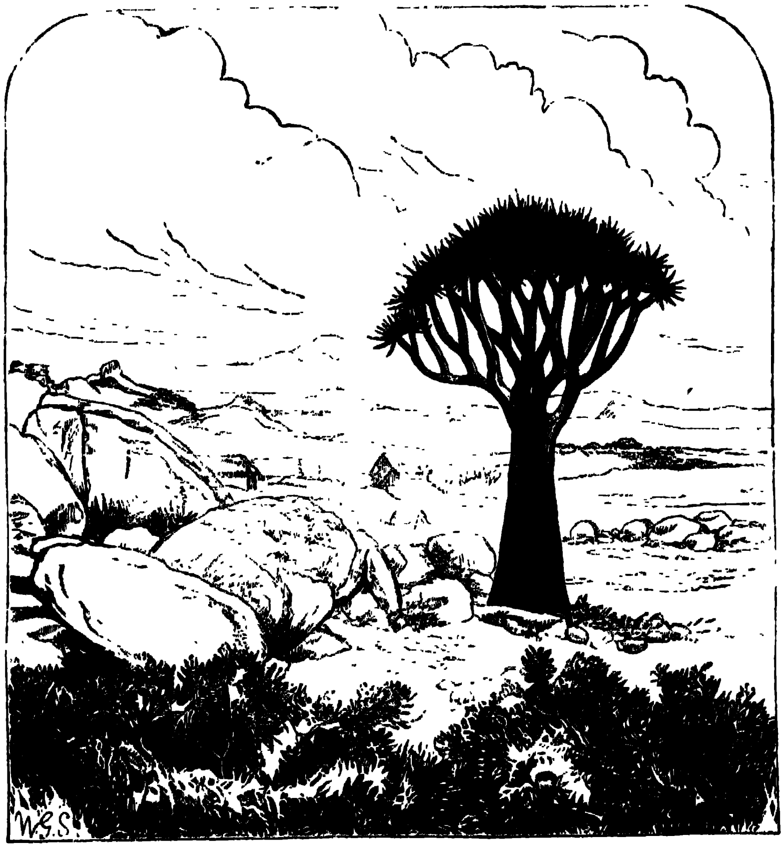

FIG. 1.—*Aloe dichotoma*, Linn., from Namaqualand.

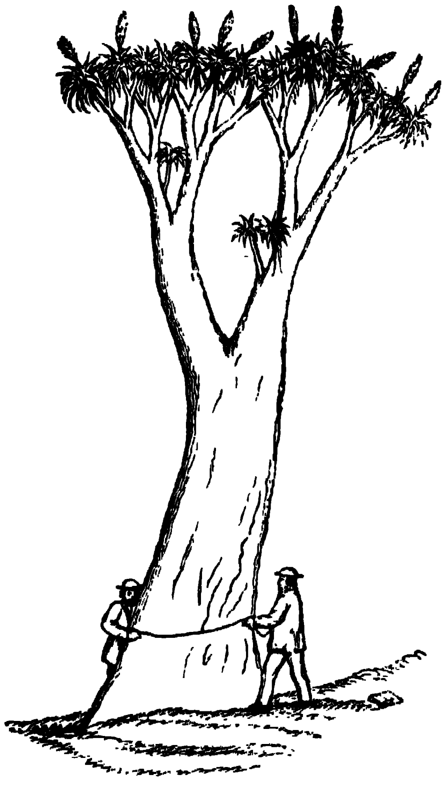

FIG. 2.—*Aloe Barberæ*, Dyer, from Kaffraria.

It may be well to mention that the true Aloes of the Old World have nothing whatever to do with the so-called "American Aloe." This is a species of *Agave*, a genus indigenous to Mexico and South America. The habit of the two genera is in many respects curiously similar, and they afford a striking instance of "homoplasy"—of the assumption by organisms essentially differing in themselves, of externally similar forms, when exposed to similar external conditions. *Aloe* commonly flowers laterally, and the growth of its main axis is therefore not arrested; *Agave*, as is generally known, flowers from its central bud, and consequently dies afterwards. *Aloe* is Liliaceous, with a superior ovary; *Agave* is Amaryllidaceous, with an inferior one. But *Aloe*, as we have seen, has passed to the New World, and *Agave* is quite as much at home now in the Old World as its representatives are.

One is at first sight hardly prepared to hear of Aloes assuming the dimensions of trees. That they do so is, however, quite certain, though our knowledge of the arborescent species was, till quite lately, extremely imperfect, and is, indeed, still far from complete. I collected together all the material I could get access to in a paper published in the *Gardener's Chronicle* for May 2 of this year. My present object, besides that of calling the attention of the readers of NATURE to these very remarkable plants, is to correct a rather important error into which I find that I have fallen respecting them.

In point of fact, it is now pretty clear that the west and east coasts of South Africa each possess one endemic Tree-Aloe. That of the west, where it is distributed from Walvisch Bay to Clanwilliam, is *Aloe dichotoma*, Linn.

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* Flückiger and Hanbury's "Pharmacographia," p. 616.

† "Punjâb Plants," p. 232.

‡ Loc. cit., p. 242.

§ Journ. Roy. Hort. Soc. New Series, vol. ii. p. 80.

well described in Paterson's "Travels in Africa" (1789), but otherwise very little known. The present Governor of the Cape, Sir Henry Barkly, has made great exertions to procure plants for Kew, and two have now arrived in this country, the largest being 8 ft. in height, but there is some doubt whether either will eventually survive the voyage.

Aloe dichotoma appears to attain a height of about 30 ft., with a girt of about 12 ft.[*] Fig. 1 is from a photograph by Mr. Chapman, and is reproduced from the *Gardener's Chronicle.* Young plants of the Aloe from Kaffraria, alluded to above by Mrs. Barber, are now in cultivation at Kew. Finding that the name by which it was known belonged to another species, *A. Zeyheri*, and that it was undescribed, I renamed it *Aloe Barberæ*, in honour of Mrs. Barber, who first sent cuttings of it to this country. Fig. 2 (which is also borrowed from the *Gardener's Chronicle*) is a copy of a rough sketch sent to this country by the Rev. R. Baur, a Moravian missionary, at present resident in Kaffraria. He speaks of it as growing in the forests to the height of 30 ft., with a girt three feet above the ground of about 16 ft. Its dimensions are therefore about the same as those of *Aloe dichotoma*. In Mr. Baur's sketch the seed-vessels are represented, and he feared that he had made them proportionately too large.

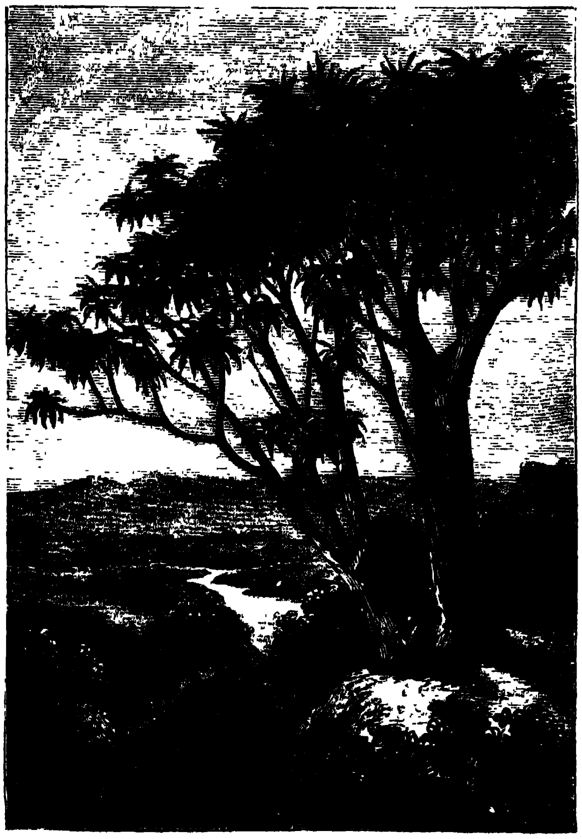

FIG. 3.—*Aloe Barberæ*, Dyer, from Natal.

An arborescent Aloe also exists in Natal. An account of this from Mr. Baines, the well-known African traveller, with a sketch of the spot where the plants occurred, was sent to Dr. Hooker with a living branch during last year. It was the subject of a communication made to the British Association at Bradford.[†] The appearance of the branch of the Natal plant was so different from that of the Kaffrarian, that I ventured to characterise it as a new species under the name of *Aloe Bainesii*, on the ground that the leaves were longer, not glaucous, and not so completely crowded into a terminal tuft. The fact of the leaves being crowded into a terminal rosette, or spaced down the stem, is found to afford a character of even sectional value among the species. I was therefore rather astonished to find that when the Natal plant had fairly established itself, its rosette of leaves began to grow out. It is apparently only in old plants that the leaves are crowded into rosettes. I do not now doubt that the Kew plant of the Natal Aloe will eventually assume quite the same appearance as plants of the Kaffrarian one, with which I am now disposed to believe it to be identical. The name *A. Bainesii* must therefore be merged as a synonym in *A. Barberæ*. The only remaining discrepancy is with respect to the flowers. Mr. Baines believes that those of his plant were orange or scarlet. Those of the Kaffrarian plant (ample specimens of which I have recently received through the kindness of Sir Henry Barkly) appear, from a sketch made by Lady Barkly, to be rose, passing into flesh-colour.

The sketch of *A. Barberæ* from Natal (Fig. 3) is from a drawing by Mr. Sanderson, of D'Urban.

The stems of these Aloes must necessarily increase "exogenously" in diameter. This, no doubt, takes place in the same way as in the well-known Dragon Tree (*Dracæna Draco*). W. T. THISELTON DYER

TRANSACTIONS AND PROCEEDINGS OF THE ROYAL SOCIETY OF VICTORIA

WE have received the Proceedings of the Royal Society of Victoria for the years 1870, 1871, and 1872, the issue of which has been delayed by the withdrawal of the Government grant in 1868, but through the liberality of the present Government we are glad to hear that the financial state of the Society enables the present report to be printed. We have read with great pleasure the addresses of the president, Mr. Ellery, showing that scientific knowledge is gaining ground fast in Victoria. Mr. Ellery tells us of the work at the Observatory, and that the positions of 38,305 stars have been established up to 1870. In 1868 the great reflector of 4 ft. diameter was mounted, and Mr. Ellery says that although his hopes were not fully realised, the telescope, if it does not excel, equals every other of its size. Mr. Le Sueur appears to have attacked η Argus and its surrounding nebula as early as possible, and in February 1870 he informs the Society that the spectrum of η is crossed by bright lines corresponding to $C\ D\ E\ F$ and one beyond F, probably $H\gamma$: the principal line of nitrogen was also seen. He therefore concludes that hydrogen, nitrogen, sodium, and magnesium are indicated. No dark lines seem to have been seen with certainty, although they were suspected. Mr. Le Sueur says: "We seem driven to the conclusion that the star consists of a solid nucleus, a gaseous envelope cooler than the nucleus producing the dark lines, and a second envelope hotter than the nucleus accounting for the bright ones." We hope we shall not be quite driven to this conclusion of a solid nucleus, which seems highly improbable. A large influx of hot hydrogen or nitrogen from the nebula or other source might be sufficient to reverse the dark lines, and as this would heat the original photosphere more intensely its absorption would be reduced, accounting for the reduction in intensity of the black lines. In January 1874 we find that Mr. Macgeorge examined this star and found no bright lines, and further, that a distinct nebulosity surrounded the star, which in December 1869 appeared, according to Le Sueur, on a black background. Mr. Macgeorge furnishes several drawings of the nebula surrounding η which show a vast change in the shape of the mass. In 1838 η was involved in dense nebula, while in 1869 it was seen on a bare sky. The further drawings by Mr. Ellery and Mr. Le Sueur are scarcely recognisable as being made from the same nebula, so vast appears the changes; in one instance the difference between two drawings shows a motion of the gas, if motion it be, of 6,000,000,000 miles a month. We have known comets' tails or jets to have a motion comparable to this—so perhaps some similar cause is acting here. Mr. L. Sueur appears to have carefully examined the spectrum of Jupiter with the Melbourne reflector, but with no very decisive results, the absorption-lines appearing constant across the slits, which leads him to infer that the light from the different parts of the visible surfaces had passed through not widely unequal thicknesses of atmosphere, or that the least thickness was sufficient to produce a maximum absorption. Mr. Ellery has been trying paper paraffined, instead of waxed, for photographing the continuous records of magnetic and other phenomena, thereby shortening the sensitising and developing by more than an hour; but he has found that by using plain paper some four hours are saved. The process he uses is a slight modification of Crooke's. A large number of enhydros or water-stones were found at Beechworth in 1864. On the granite rock near Beechworth is a Silurian outlier of sandstone, intersected with veins of blue quartz, and in the widening of these veins the stones appear. They lie in nests lined with scales of chalcedony and fine clay. Mr. Dunn describes the enhydros as consisting of chalcedony, irregular in form, bounded by true planes varying in colour, from yellow and opaque to quite colourless and transparent, and their size from 5 in. diameter to the size of a split pea. The contents of the stones appear from analysis by Mr. Foord to consist of water slightly mineralised with chloride and sulphate of sodium, magnesium, calcium, and a soluble form of silicic acid. Mr. Macgeorge has been at work observing the small stars near Sirius. We copy his diagram of these stars, all of which require large optical means to render them visible: the position of Alvan Clarke's comet in January 1865 is given as 77° 63', and that of Lassell's companion 163° 89'. We are glad to see papers on the colonial timber trees, discussing the suitability of certain trees to the climate. Amongst our English trees that thrive there, are the oak, elm, ash, walnut, willow; the larch, pines, and poplars, however, seem unsuited. The red and blue gums and the blackwood seem to be amongst the most useful indigenous trees. The poisoning of water and air in Melbourne has also been occupying the attention of the Society, and Mr. Gibbons furnishes the report with several well-executed micro-photographs of the water from sewage, and drinking water from the Yan-Zean reservoir, in which forms of life appear in abundance. Numerous other papers of interest appear in the report, and we must congratulate the Society on so good a show of research.

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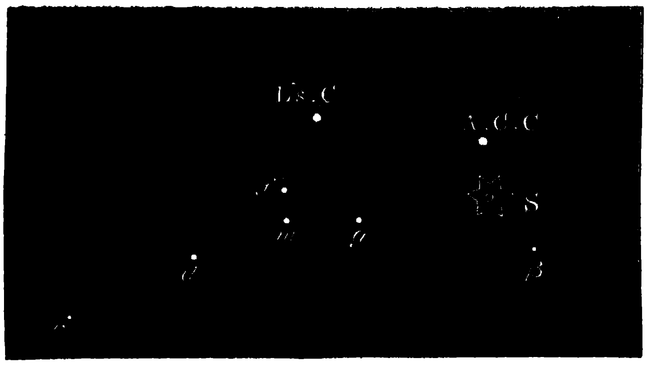
[*] By an unfortunate misprint in the *Gardener's Chronicle* (copied by Flückiger and Hanbury, *loc. cit.*), 30 ft. is given as the greatest girt.

[†] See *Journal of Botany*, 1873, p. 348. The sketch is reproduced in the *Gardener's Chronicle*, loc. cit.



G. M. S.

NOTES

The Anniversary Meeting of the Royal Society was held on Monday last; the list of the new Council we have already given. Owing to the absence of the President from domestic affliction, the chair was occupied by the Secretary, Mr. Spottiswoode. At the dinner in the evening three members of the Government were present—Lords Carnarvon and Salisbury, and Mr. W. Hunt. Lord Carnarvon in his speech gave out "no uncertain sound" as to what he deemed the duty of Government in the matter of endowment of scientific research; he virtually agreed to all the principles which we have so long and so strenuously advocated. We may therefore hope that the money to be devoted to the new Arctic Expedition is only a first instalment of what the Government think is due by the country to the promotion of directly unremunerative research.

The command of the Arctic Expedition will be offered to one of those officers who acquired a thorough knowledge, in former expeditions, of sledge travelling, and of the true system of bringing men healthy and cheerful through an arctic winter. Thus it is intended that the present undertaking should start with the advantage of all the practical knowledge and all the experience which was accumulated in the searches for Franklin. It will also be composed of the pick of our educated young officers, and will so combine matured experience with dash and vigour. An important position will, we have no doubt, be offered to Commander A. H. Markham, whose qualifications for the post have already been well tested.

The Oxford Professor of Geology, Mr. Prestwich, will deliver his inaugural lecture at the Museum on Friday, December 11, at 2 P.M.

The Cambridge Board of Medical Studies have reported to the Vice-Chancellor that they have been engaged during the present term in revising the regulations for proceedings in medicine, and are desirous of recommending some changes. The Board are of opinion that it is expedient for the University to establish examinations and grant certificates of competency in so much of state medicine as is comprised in the functions of the officers of health. The certificate given to successful candidates should testify only to their competent knowledge of what is required for the duties of an officer of health. The Board recommend the following for the subjects of examination:—1. Physics and Chemistry. The principles of chemistry and methods of analysis, with special reference to analyses (microscopical as well as chemical) of air and water; the Laws of Heat, and the principles of Pneumatics, Hydrostatics, and Hydraulics, with special reference to ventilation, water supply, drainage, construction of dwellings, and sanitary engineering in general. 2. Laws relating to Public Health. 3. Sanitary Statistics. 4. Origin, Propagation, Pathology, and Prevention of Epidemic and Infectious Diseases; effects of overcrowding, vitiated air, impure water, and bad or insufficient food; unhealthy occupations, and the diseases to which they give rise; water supply, and disposal of sewage and refuse; nuisances injurious to health; distribution of diseases within the United Kingdom, and effects of soil, season, and climate. The Vice-Chancellor has convened a meeting of general members of the Senate for to-day, in the Arts School, for the discussion of the report.

It will be proposed in a Convocation to be held at Oxford on the 9th of December, that a sum not exceeding 100*l*. be placed at the disposal of Dr. Rolleston, Prof. H. J. S. Smith, and the Rev. Hereford B. George, M.A., of New College, for the purpose of purchasing archæological objects relating to Prehistoric periods, to be placed in the University Museum.

The following telegram is dated Aden, Nov. 28:—"Letters have been received from Lieut. Cameron to the 16th of May.

His party were all well. He had circumnavigated the Tanganyika Lake, and found the effluent south of Speke's Islands, which the natives reported to be Congo, identical with Livingstone's Lualaba. He hopes to reach Jellala Falls and Loanda."

South Australian papers record with the utmost satisfaction the success of Mr. John Forrest in crossing from the western coast of Australia to the Overland Telegraph, through the very heart of the only extensive region in Australia which remains unexplored. He and his companions travelled nearly 2,000 miles, keeping close to the 26th parallel of south latitude. They left Champion Bay on April 1, and reached the telegraph line on Sept. 27. Much of the territory passed over was of the poorest possible description, and for 600 miles the travellers had to force their way through a spinifex desert scantily supplied with water. They had several times to fight the natives. Mr. Forrest has narrowed down, within very moderate limits, the unexplored territory lying between the settled districts of South and Western Australia. His achievement leaves only the direct and more southern route to Perth to be traversed in order to complete the data requisite for giving to the world a fair general insight into the character of the West Australian Continent.

The American Academy of Sciences held its half-yearly session at Philadelphia on Nov. 3, 4, and 5 last, when a number of valuable papers were read. We have only space for the titles of the more important :—"Results derived from an examination of the U.S. Weather Maps for 1872—3," by Prof. E. Loomis; "The Composite Nature of the Electric Discharge," by Prof. A. M. Mayer; "The Decay of Crystalline Rocks," by Prof. T. Sterry Hunt; "Geological Survey of Colorado," by Dr. F. V. Hayden. Dr. Hayden exhibited photographs of ruined cities and villages discovered by his party in the cañons leading into the Colorado River and upon the plains in the vicinity, supposed to have been built more than 1,000 years ago by the ancestors of the present Moquis Indians. The important fact established by these discoveries is, that there once existed in what are now the arid plains and savage gorges of South-eastern Colorado a race so far civilised that they built large cities, constructing their houses of well-hewn blocks of stone, with timber floors, well-formed windows and doorways, and smoothly plastered walls, and that they possessed the art of making glazed pottery.—"Nervous System of Limulus," by Mr. A. S. Packard, jun.; "Measuring Minute Changes in Atmospheric Pressure," by Prof. A. M. Mayer; "Effect of Wind on Sound Waves," by Prof. Joseph Henry; "Removal of Ammonia from Illuminating Gas," by Prof. B. Silliman; "Physical Measurement of the Horizontal Pendulum," and "Effect of Magnetism on Iron," by Prof. O. N. Rood; "Palæontological Evidence of the Ages of Strata," by Prof. Theodore Gill.

If adulteration in England has become one of the arts, it is certain that we are not looked down upon by all nations as being beyond compare in this nefarious practice. A large trade has hitherto existed between Aleppo and England in extract of scammony; but we are told that comparatively little is now exported. "On account of its mixture with other substances," only twenty cases in all, weighing 2,100 lbs., were shipped during the past year, the value of which was 1,680*l.*, and the whole of this came to England. In the previous year, 737 cases were exported, showing that adulteration alone is rapidly driving this article out of the import market, for the roots are produced as abundantly as ever, and are dug up and sent to England, the extract being procured from them in this country. 467 cases, weighing 93,340 lbs., and valued at 362*l.*, were shipped from Aleppo to England in 1873. Considering the bulk and weight of the roots as compared with that of the extract and the consequent increase of the cost of freight, it would seem that this exportation of the roots themselves can scarcely be a profitable trade to the shippers, inasmuch as 467 cases are valued only at 362*l.*, while twenty cases of the extract are worth 1,680*l.*

We learn from a report on the trade and commerce of Maine U.S., that the quantity of lobster packed in cans in the factories of the coast in 1873 was 1,600,000 lb., mostly in 1 lb. cans. In addition to these, the same firms packed at their establishments in Nova Scotia over 2,000,000 cans, making the total amount packed by Portland houses in the past year, 3,600,000 cans of lobster. Besides other products which are packed in tins in America, as well for home consumption as for exportation, green maize is one of the most important; 4,000,000 cans of this maize were packed in Maine during the past year. In California a large and increasing trade is carried on in curing or drying fruits, which at one time was done by exposure of the fruits to the air. This, however, has been superseded by the process of desiccating with a blast of hot air. By this means the fruits retain all their freshness of flavour.

The scarcity of oysters, which is now attracting renewed public attention, is a question which intimately affects a large number of people. The point is quite as important to the public as that of the scarcity of salmon, which was taken up by the Legislature thirteen years ago. Whether, as two rival parties of theorists maintain, the failure is due to natural causes or to over-dredging, the result to the public is the same, and it will only be by some systematic investigation that the doubts will be set at rest. That unfavourable weather should be the sole cause of the scarcity of oysters, for a dozen successive years, is very hard to believe; and though it is only natural that weather should have some effect upon the produce of these bivalves, it is more probable that overdredging is equally if not more to blame. In such a case some restrictions are necessary, and these restrictions can only be enforced by the action of Parliament.

A few weeks ago we alluded to the suggestion made by the Government of Newfoundland for the establishment of a close time for seals. We are glad to see that our own Government are also alive to the necessity for some steps being taken to prevent the annual slaughter of thousands of young and immature and breeding seals which takes place at present. The first step will be to take the opinions of the owners of sealing vessels on the advisability of such a course, and with this object we understand that the officials of the Board of Trade have already arranged to visit the principal sealing ports of Scotland.

The *Daily News* of Tuesday has a letter from its correspondent with the Egyptian Transit Expedition, dated Thebes, Nov. 9, from which we learn that the astronomers have located themselves on an island to the south of Karnak. So far everything has gone well, and if the weather only prove favourable the work is likely to be successful. To the east the horizon is unobstructed by anything except a distant range of hills, which cannot measure more than one angular degree.

A correspondent, "H. B. P.," writes to correct Dr. Petermann's statement quoted in last week's article (p. 61) that the Ashantee War "cost nine millions sterling." "The utmost cost of the Ashantee expedition," our correspondent states, and he writes from the War Department, Woolwich, "was seventeen or eighteen hundred thousand pounds, and this includes stores innumerable, which were returned unshipped, and which have depreciated but little in value." This, however, in no way invalidates the force of Dr. Petermann's statement so far as concerns the purpose for which we adduced it.

Mr. J. V. Jones, of University College, London, has been elected to the Brackenbury Natural Science Scholarship in connection with Balliol College, Oxford.

THE observations of the November swarm of falling stars at the several French stations had no result. It seems pretty certain that the phenomenon is now at its lowest ebb of brilliancy.

M. CHEVREUL, the director of the Paris Museum, has resigned his office owing to difficulties in the nomination of a professor. The administration and the professors have come to the conclusion that the appointment must be postponed for a year, and a *suppléant* will deliver the lectures.

THE first number of a new monthly illustrated periodical, largely devoted to science, has just appeared in Paris. It is entitled, *Revue Illustrée des Lettres, Sciences, Arts, et Industries dans les Deux Mondes.*

Annales Télégraphiques, a periodical issued by the French administration, but in abeyance for the last eight years, has again reappeared.

M. MARTIN, a French telegraphic engineer, has invented an engine for recording votes. The contrivance has been designed on the principle of the *sonnettes électriques*, and is exhibited in a shop in the Place Dauphine. The peculiarity is that the votes are registered and their total reckoned automatically. The invention is attracting public notice, as it is expected that the Versailles representatives will have an immense number of votes to register during the next session.

MR. ERNEST INGERSOLL, of Boston, U.S., who accompanied the party of Dr. Hayden during the past summer, as zoologist, has returned with a large quantity of specimens of natural history, which he is engaged in working up for publication. An important feature of this series consists in a very extensive collection of land and freshwater shells, a branch which has been too much neglected lately by explorers, to whom recent and fossil vertebrates have had greater attractions. Mr. Ingersoll was greatly surprised at the number and character of the molluscan forms secured in Colorado, as also their strange distribution and stations, and is confident that the facts which he has to present will be considered extremely interesting to conchologists.

AMONG the gaps that have remained unfilled in the series of reports of the Wilkes Expedition has been that on the plants collected by the party, partly in consequence of the failure of the U.S. Congress to make the necessary appropriations, and partly on account of the death of Dr. Torrey, who had charge of the phenogamous portion. This volume, however, has lately appeared, Dr. Gray having undertaken the work of Dr. Torrey after his death. That part relating to the cryptogamous plants (consisting of the mosses) had been already published in several portions—that on the mosses as prepared by Mr. W. S. Sullivant, that of the lichens by Prof. Tuckerman, and that on the algæ by Professors Bailey and Harvey; the fungi by the late Dr. Curtis and Mr. Berkeley. The volume is an imperial quarto of 420 pages of letter-press, and contains twenty-nine plates. Of this only twenty copies are on sale, to be had of Westermann and Co., New York, and at the Herbarium of Harvard University.

THE Council of the Society of Arts have arranged with Prof. McLeod, of the India Engineering College, Cooper's Hill, to deliver two lectures (on dates to be hereafter determined) during the Christmas holidays. The subject will be "The Work and Food of the Iron Horse."

A SEVERE earthquake shock was felt in Chili shortly after midnight on Sept. 26. It extended as far north as Copiapo, and south as far as Talca, and was the heaviest shock experienced since the memorable one of July 7 last year. Valparaiso, Santiago, and intermediate country were almost on the focus of the intensity of the shock. The earthquake travelled from east to west. The temperature immediately rose two degrees and six-tenths. The night was beautifully clear. Several slight tremors were felt during the ensuing week.

THE Hastings and St. Leonards Philosophical and Historical Society, which has entered on the seventeenth year of its work, is on the whole in a healthy condition. A number of the members have undertaken to investigate the science of the neighbourhood in connection with botany, zoology, archæology, geology, meteorology, &c., so that we may expect by and by some results of substantial value.

IT is gratifying to hear that an attempt is being made to create an interest in science in North London. A series of lectures on scientific subjects are being given in the Athenæum, Camden Road, at a very moderate price, and we hope the result will be the formation of a North London Scientific Society and Field Club, somewhat after the model of the one recently started in West London. These North London lectures we shall notify in our "Diary."

A RECENT number of the *Australian Sketcher* contains a very interesting account of the great Melbourne telescope, with which so much good work has already been done by Mr. Ellery and his staff; a series of well-executed illustrations accompany the paper. It is, as the article justly concludes, to the credit of the colony that amidst its prevalent utilitarianism it remembered and recognised the claims of science to the degree implied in the purchase and support of so noble an instrument. The telescope cost about 5,000*l.*, in addition to the sum of 1,500*l.* for the house.

WE are glad to see that Mr. W. G. Valentin's "Course of Qualitative Chemical Analysis" (Churchill) has reached a third edition.

DR. WEINHOLD'S excellent "Vorschule der Experimentalphysik," which we noticed in vol. iv. p. 158, has reached a second edition, in which the author has brought his work up to time.

"BEAUTY in Common Things" is the title of a very pretty quarto volume published by the Society for Promoting Christian Knowledge. It consists of twelve chromolithographed drawings from nature by Mrs. J. W. Whymper, with descriptive text by the author of "Life Underground." The drawings are all of the most common plants, such as the Bramble, the Wild Strawberry, Furze Blossom, Blackthorn, Mushrooms, &c.; but while perfectly faithful to nature, the arrangement and execution are so artistic as to afford genuine pleasure. The text is pleasant and informing, and altogether the book is a very beautiful Christmas present, and likely to give children into whose hands it may fall, a taste for the study of nature.

WE have received the fifth edition (dated 1875) of Dr. J. H. Bennett's very interesting book, "Winter and Spring on the Shores of the Mediterranean" (Churchill). We recommend it to those in search of a genial winter home.

FROM Liverpool comes a carefully compiled "Synopsis of an Arrangement of Invertebrate Animals in the Free Public Museum of Liverpool," by the Rev. H. H. Higgins, M.A. Prefixed is an introduction the substance of which appeared in two articles by Mr. Higgins, in NATURE, vol. iii. pp. 202 and 481.

THE Geological, Botanical, and Natural History Section of the Catalogue of the Leeds Public Library contains the names of many valuable works of reference. Some of our readers may be glad to know that access can be had at all times to any of the works mentioned in the catalogue.

THE additions to the Zoological Society's Gardens during the past week include two Great Kangaroos (*Macropus giganteus*), from New South Wales, presented by Mr. A. Nicol; two Common Boas (*Boa constrictor*), two Agoutis (*Dasyprocta?*), from St. Lucia, presented by Mr. Neville Holland; a Virginian Deer (*Cervus virginianus*), from South America, presented by Capt. E. H. Cobbett; a Gazelle (*Gazella dorcas*), from Egypt, presented by Miss Lancaster; a Common Peafowl (*Pavo cristatus*), from India, presented by the Hon. A. S. G. Canning; a Vervet Monkey (*Cercopithecus lalandii*), from South Africa; and a Sun Badger (*Helictis moschata*), from East Asia, new to the collection.

THE "CHALLENGER" EXPEDITION[*]

DURING our southern cruise the sounding-lead brought up five absolutely distinct kinds of sea-bottom, without taking into account the rock and detritus of shallow soundings in the neighbourhood of land. Our first two soundings in 98 and 150 fathoms on the 17th and 18th of December were in the region of the Agulhas current. These soundings would have been naturally logged "greenish sand," but on examining the sandy particles with the microscope, they were found to consist almost without exception of the casts of foraminifera in one of the complex silicates of alumina, iron, and potash, probably some form of glauconite. The genera principally represented by these casts were Miliola, Biloculina, Uvigerina, Planorbulina, Rotalia, Textularia, Bulimina, and Nummulina; Globigerina, Orbulina, and Pulvinulina were present, but not nearly in so great abundance. There were very few foraminifera on the surface of the sea at the time. This kind of bottom has been met with once or twice before; but it is evidently exceptional, depending upon some peculiar local conditions.

From the Cape, as far south as our station in lat. 46° 16′, we found no depth greater than 1,900 fathoms, and the bottom was in every case "Globigerina ooze;" that is to say, it consisted of little else than the shells of Globigerina, whole, or more or less broken up, with a small proportion of the shells of Pulvinulina and of Orbulina, and the spines and tests of radiolarians and fragments of the spicules of sponges.

Mr. Murray has been paying the closest attention since the time of our departure to the question of the origin of this calcareous formation, which is of so great interest and importance on account of its anomalous character and its enormous extension. Very early in the voyage he formed the opinion that all the organisms entering into its composition at the bottom are dead, and that all of them live abundantly at the surface and at intermediate depths over the Globigerina-ooze area, the ooze being formed by the subsiding of these shells to the bottom after death.

This is by no means a new view. It was advocated by the late Prof. Bailey, of West Point, shortly after the discovery, by means of Lieut. Broke's ingenious sounding instrument, that such a formation had a wide extension in the Atlantic. Johannes Müller, Count Pourtales, Krohn, and Max-Schultze, observed Globigerina and Orbulina living on the surface; and Ernst Hæckel, in his important work upon the Radiolaria, remarks that "we often find upon, and carried along by the floating pieces of seaweed which are so frequently met with in all seas, foraminifera as well as other animal forms which habitually live at the bottom." However, setting aside these accidental instances, certain foraminifera, particularly in their younger stages, occur in some localities so constantly and in such numbers, floating on the surface of the sea, that the suspicion seems justifiable that they possess, at all events at a certain period of their existence, a pelagic mode of life, differing in this respect from most of the remainder of their class. Thus Müller often found in the contents of the surface-net off the coast of France the young of Rotalia, but more particularly Globigerinæ and Orbulinæ, the two latter frequently covered with fine calcareous tubes, prolongations of the borders of the fine pores through which the pseudogradia protrude through the shell. I took similar Globigerinæ and Orbulinæ almost daily in a fine net at Messina, often in great numbers, particularly in February. Often the shell was covered with a whole forest of extremely long and delicate calcareous tubes projecting from all sides, and probably contributing essentially to enable these little animals to float below the surface of the water by increasing their surface greatly, and consequently their friction against the water, and rendering it more difficult for them to sink."[*] In 1865 and 1866 two papers were read by Major Owen, F.L.S., before the Linnean Society, "On the Surface Fauna of Mid-Ocean." In these communications the author stated that he had taken foraminifera of the genera Globigerina and Pulvinulina, living, in the tow-net on the surface, at many stations in the Indian and Atlantic Oceans. He described the special forms of these genera which were most common, and gave an interesting account of their habits, proposing for a family which should include Globigerina, with Orbulina as a sub-genus, and Pulvinulina, the name Colymbitæ, from the circumstance that, like the Radiolaria, these foraminifera are found on the surface after sunset, "diving" to some depth beneath it during the heat of the day. Our colleague, Mr. Gwyn Jeffreys, chiefly on the strength of Major Owen's papers, maintained that certain foraminifera were surface animals, in opposition to Dr. Carpenter and myself.[†] I had formed and expressed a very strong opinion on the matter. It seemed to me that the evidence was conclusive that the foraminifera which formed the Globigerina ooze lived on the bottom, and that the occurrence of individuals on the surface was accidental and exceptional; but after going into the thing carefully, and considering the mass of evidence which has been accumulated by Mr. Murray, I now admit that I was in error; and I agree with him that it may be taken as proved that all the materials of such deposits, with the exception, of course, of the remains of animals which we now know to live at the bottom at all depths, which occur in the deposit as foreign bodies, are derived from the surface.

Mr. Murray has combined with a careful examination of the soundings a constant use of the tow-net, usually at the surface, but also at depths of from ten to one hundred fathoms; and he finds the closest relation to exist between the surface fauna of any particular locality and the deposit which is taking place at the bottom. In all seas, from the equator to the polar ice, the tow-net contains Globigerinæ. They are more abundant and of a larger size in warmer seas; several varieties, attaining a large size and presenting marked varietal characters, are found in the intertropical area of the Atlantic. In the latitude of Kerguelen they are less numerous and smaller, while further south they are still more dwarfed, and only one variety, the typical *Globigerina bulloides*, is represented. The living Globigerinæ from the tow-net are singularly different in appearance from the dead shells we find at the bottom. The shell is clear and transparent, and each of the pores which penetrate it is surrounded by a raised crest, the crest round adjacent pores coalescing into a roughly hexagonal network, so that the pores appears to lie at the bottom of a hexagonal pit. At each angle of this hexagon the crest gives off a delicate flexible calcareous spine, which is sometimes four or five times the diameter of the shell in length. The spines radiate symmetrically from the direction of the centre of each chamber of the shell, and the sheaves of long transparent needles crossing one another in different directions have a very beautiful effect. The smaller inner chambers of the shell are entirely filled with an orange-yellow granular sarcode; and the large terminal chamber usually contains only a small irregular mass, or two or three small masses run together, of the same yellow sarcode stuck against one side, the remainder of the chamber being empty. No definite arrangement and no approach to structure was observed in the sarcode, and no differentiation, with the exception of round bright-yellow oil-globules, very much like those found in some of the radiolarians, which are scattered apparently irregularly in the sarcode. We never have been able to detect in any of the large number of Globigerinæ which we have examined the least trace of pseudopodia, or any extension in any form of the sarcode beyond the shell.

Major Owen (*op. cit.*) has referred the Globigerina with spines to a distinct species, under the name of *G. hirsuta*. I am inclined rather to believe that all Globigerinæ are to a greater or less degree spiny when the shell has attained its full development. In specimens taken with the tow-net the spines are very usually absent; but that is probably on account of their extreme tenuity; they are broken off by the slightest touch. In fresh examples from the surface, the dots indicating the origin of the lost spines may almost always be made out with a high power. There are never spines on the Globigerinæ from the bottom, even in the shallowest water. Two or three very marked varieties of Globigerina occur; but I certainly do not think that the characters of any of them can be regarded as of specific value.

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[*] "Preliminary Notes on the Nature of the Sea-bottom procured by the Soundings of H.M.S. *Challenger* during her Cruise in the Southern Sea in the early part of the year 1874." By Prof. C. Wyville Thomson, F.R.S., director of the Civilian Scientific Staff on board. Read before the Royal Society, Nov. 26, 1874.

[*] "Die Radiolarien." Eine Monographie von Dr. Ernst Hæckel. Berlin, 1862, pp. 165, 167

[†] Mr. Jeffreys desires to record his dissent from this conclusion, since (from his own observations, as well as those of Major Owen and Lieut. Palmer) he believes Globigerina to be exclusively an oceanic foraminifera inhabiting only the superficial stratum of the sea. (Preliminary Report of the Scientific Exploration of the Deep Sea, "Proceedings of the Royal Society," No. 121, page 443.)

There is still a good deal of obscurity about the nature of *Orbulina universa*, an organism which occurs in some places in large proportion in the Globigerina ooze. The shell of Orbulina is spherical, usually about ·5 millimetre in diameter, but it is found of all smaller sizes. The texture of the mature shell resembles closely that of Globigerina, but it differs in some important particulars. The pores are markedly of two different sizes, the larger about four times the area of the smaller. The larger pores are the less numerous; they are scattered over the surface of the shell without any appearance of regularity; the smaller pores occupy the spaces between the larger. The crests between the pores are much less regular in Orbulina than they are in Globigerina; and the spines, which are of great length and extreme tenuity, seem rather to arise abruptly from the top of scattered papillæ than to mark the intersections of the crest. This origin of the spines from the papillæ can be well seen with a moderate power on the periphery of the sphere. The spines are hollow and flexible; they naturally radiate regularly from the direction of the centre of the sphere; but in specimens which have been placed under the microscope with the greatest care they are usually entangled together in twisted bundles. They are so fragile that the weight of the shell itself, rolling about with the motion of the ship, is usually sufficient to break off the whole of the spines and leave the papillæ only projecting from its surface in the course of a few minutes. In some examples, either those in process of development, or a series showing a varietal divergence from the ordinary type, the shell is very thin and almost perfectly smooth, with neither papillæ nor spines, nor any visible structure, except the two classes of pores, which are constant.

The chamber of Orbulina is often almost empty; even in the case of examples from the surface, which appears from the freshness and transparency of the shell to be living, it is never full of sarcode; but it frequently contains a small quantity of yellow sarcode stuck against one side, as in the last chamber of Globigerina. Sometimes, but by no means constantly, within the chamber of Orbulina there is a little chain of three or four small chambers singularly resembling in form, in proportion, and in sculpture, a small Globigerina; and sometimes, but again by no means constantly, spines are developed on the surface of the calcareous walls of these inner chambers, like those on the test of Globigerina. The spines radiate from the position of the centre of the chambers and abut against the insides of the wall of the Orbulina. In a few cases the inner chambers have been observed apparently arising within or among the sarcode adhering to the wall of the Orbulina.

Major Owen regards Orbulina as a distinct organism, nearly allied to Globigerina, but differing so far from it as to justify its separation into a special subgenus. He considers the small inner chamber of Orbulina as representing the smaller chamber of Globigerina, and the outer wall as the equivalent of the large outer chamber of Globigerina developed in this form as an investing chamber. Count Pourtales, Max-Schultze, and Krohn, on the other hand, believe, on account of the close resemblance in structure between the two shells, their constant association, and the undoubted fact that an object closely resembling a young Globigerina is often found within Orbulina, that the latter is simply a special reproductive chamber budded from the former, and capable of existing independently. I am rather inclined to the latter view, although I think much careful observation is still required to substantiate it; and some even of our own observations would seem to tell somewhat in the opposite direction. Although Orbulina and Globigerina are very usually associated, in different localities, they are so in different proportions; and in the icy sea to the south of Kerguelen, although Globigerina was constantly taken in the surface-net, not a single Orbulina was detected. Like Globigerina, Orbulina is most fully developed and most abundant in the warmer seas.

Associated with these forms, and, like them, living on the surface and dead, and with their shells in various stages of decay at the bottom, there are two very marked species or varieties of Pulvinulina, *P. menardii*, and *P. micheliniana*. The general structure of Pulvinulina resembles that of Globigerina. The shell consists of a congeries of from five to eight chambers arranged in an irregular spiral. As in Globigerina, the last chamber is the largest; the inner smaller chambers are usually filled with yellow sarcode; and as in Globigerina, the last chamber is frequently nearly empty, a small irregular mass of sarcode only occupying a part of the cavity. The walls of the chambers are closely and minutely perforated. The external surface of the wall is nearly smooth, and no trace of a spine has ever been detected. *Pulvinulina menardii* has a large discoidal depressed shell, in diameter consisting of a series of flat chambers overlapping one another, like a number of coins laid down somewhat irregularly, but generally in a spiral: each chamber is bordered by a distinct somewhat thickened solid rim of definite width. On the lower surface of the shell the intervals between the chambers are indicated by deep grooves. The large irregular opening of the final chamber is protected by a crescentic lip, which in some specimens bears a fringe of spine-like papillæ. This form is almost confined to the warmer seas. It is very abundant on the surface, and still more so during the day, at a depth of ten to twenty fathoms in the Mid-Atlantic; and it enters into the composition of the very characteristic Globigerina ooze of the "Dolphine Rise" in almost as large proportions as Globigerina. *Pulvinulina micheliniana* is a smaller variety; the upper surface of the shell is flattened as in *P. menardii*, but the chambers are conical and prolonged downwards, so that the shell is deeper and somewhat turbinate. The two species usually occur together; but *P. micheliniana* has apparently a much wider distribution than *P. menardii*, in which the former was limited to the region of the trade-winds and the equatorial drift-current, and was found rarely, if at all, to the south of the Agulhas current; the latter accompanied us southward as far as Kerguelen Land. Both forms of Pulvinulina, however, are more restricted than Globigerina, for even *P. micheliniana* became scarce after leaving the Cape, and the wonderfully pure calcareous formation in the neighbourhood of Prince Edward Island and the Crozets consists almost solely of *Globigerina bulloides*; and neither species of Pulvinulina occurred to the south of Kerguelen Land.

Over a very large part of the "Globigerina-ooze" area, and especially in those intertropical regions in which the formation is most characteristically developed, although the great bulk of the ooze is made up of entire shells and fragments of shells of the above-described foraminifera, besides these there is frequently a considerable proportion (amounting in some cases to about twenty per cent.) of fine granular matter, which fills the shells and the interstices between them, and forms a kind of matrix or cement. This granular substance is, like the shells, calcareous, disappearing in weak acid to a small insoluble residue: with a low microscopic power it appears amorphous, and it is likely to be regarded at first sight as a paste made up of the ultimate calcareous particles of the disintegrated shells, but under a higher power it is found to consist almost entirely of "coccoliths" and "rhabdoliths." I need scarcely enter here into a detailed description of these singular bodies, which have already been carefully studied by Huxley, Sorby, Gümbel, Carter, Oscar Schmidt, Wallich, and others. I need only state that I believe our observations have placed it beyond a doubt that the "coccoliths" are the separated elements of a peculiar calcareous armature which covers certain spherical bodies (the "coccospheres" of Dr. Wallich.) The rhabdoliths are the like elements of the armature of extremely beautiful little bodies, which have been first observed by Mr. Murray, and naturally called by him "rhabdospheres. Coccospheres and rhabdospheres live abundantly on the surface, especially in warmer seas. If a bucket of water be allowed to stand over night with a few pieces of thread in it, on examining the threads carefully many examples may usually be found attached to them; but Mr. Murray has found an unfailing supply of all forms in the stomachs of Salpæ.

What these coccospheres and rhabdospheres are we are not yet in a position to say with certainty; but our strong impression is that they are either algæ of a peculiar form, or the reproductive gemmules, or the sporangia of some minute organism, probably an alga, in which latter case the coccoliths and rhabdoliths might be regarded as representing in position and function the "amphidisci" on the surface of the gemmules of Spongilla, or the spiny facets on the zygospores of many of the Desmideæ. There are many forms of coccoliths and rhabdoliths, and many of these are so distinct that they evidently indicate different species. Mr. Murray believes, however, that only one form is met with on one sphere; and that in order to produce the numerous forms figured by Hæckel and Oscar Schmidt, all of which, and many additional varieties, he has observed, the spheres must vary in age and development, or in kind. Their constant presence in the surface-net, in surface-water drawn in a bucket, and in the stomachs of surface animals, sufficiently prove that, like the ooze-forming foraminiferes, the coccoliths and rhabdoliths, which enter so largely into the composition of the recent deep-sea calcareous formations, live on the surface and at intermediate depths, and sink to the bottom after death. Coccospheres and rhabdospheres have a very wide but not an unlimited distribution. From the Cape of Good Hope they rapidly decreased in number on the surface, and at the bottom as we progressed southwards. The proportion of their remains in the Globigerina ooze near the Crozets and Prince Edward Island was comparatively small; and to this circumstance the extreme clearness and the unusual appearance of being composed of Globigerinæ alone was probably mainly due. We found the same kind of ooze nearly free from coccoliths and rhabdoliths in what may be considered about a corresponding latitude in the north, to the west of Faröe.

Before leaving the subject of the modern chalk, it may be convenient to pass on to stations 158, 159, and 160, on March 7th, 10th, and 13th, on our return voyage from the ice. The first two of these, at depths of 1,800 and 2,150 fathoms respectively, are marked on the chart "Globigerina ooze;" and it will be observed that these soundings nearly correspond in latitude with the like belt which we crossed going southwards; the third sounding at a depth of 2,600 fathoms is marked "red clay."

According to our present experience the deposit of Globigerina ooze is limited to water of a certain depth, the extreme limit of the pure characteristic formation being placed at a depth of somewhere about 2,250 fathoms. Crossing from these shallower regions occupied by the ooze into deeper soundings, we find universally that the calcareous formation gradually passes into and is finally replaced by an extremely fine pure clay, which occupies, speaking generally, all depths below 2,500 fathoms, and consists almost entirely of a silicate of the red oxide of iron and alumina. The transition is very slow, and extends over several hundred fathoms of increasing depth; the shells gradually lose their sharpness of outline and assume a kind of "rotten" look and a brownish colour, and become more and more mixed with a fine amorphous red-brown powder, which increases steadily in proportion until the lime has almost entirely disappeared. This brown matter is in the finest possible state of subdivision, so fine that when, after sifting it to separate any organisms it might contain, we put it into jars to settle, it remained for days in suspension, giving the water very much the appearance and colour of chocolate.

In indicating the nature of the bottom on the charts, we came, from experience and without any theoretical consideration, to use three terms for soundings in deep water. Two of these, Gl. oz. and r. cl., were very definite, and indicated strongly marked formations, with apparently but few characters in common; but we frequently got soundings which we could not exactly call either "Globigerina ooze" or "red clay;" and before we were fully aware of the nature of these we were in the habit of indicating them as "grey ooze" (gr. oz.) We now recognise the "grey ooze" as an intermediate stage between the Globigerina ooze and the red clay; we find that on one side as it were of an ideal line, the red clay contains more and more of the material of the calcareous ooze, while on the other the ooze is mixed with an increasing proportion of "red clay.'

Although we have met with the same phenomenon so frequently that we were at length able to predict the nature of the bottom from the depth of the sounds with absolute certainty for the Atlantic and the Southern Sea, we had perhaps the best opportunity of observing it in our first section across the Atlantic, between Teneriffe and St. Thomas. The first four stations on this section, at depths from 1,525 to 2,220 fathoms, show Globigerina ooze. From the last of these, which is about 300 miles from Teneriffe, the depth gradually increases to 2,740 fathoms at 500, and 2,950 fathoms at 750 miles from Teneriffe. The bottom in these two soundings might have been called "grey ooze;" for although its nature has altered entirely from the Globigerina ooze, the red clay into which it is rapidly passing still contains a considerable admixture of carbonate of lime.

The depth goes on increasing to a distance of 1,150 miles from Teneriffe, when it reaches 3,150 fathoms; there the clay is pure and smooth, and contains scarcely a trace of lime. From this great depth the bottom gradually rises, and with decreasing depth the grey colour and the calcareous composition of the ooze return. Three soundings in 2,050, 1,900, and 1,950 fathoms on the "Dolphin Rise," gave highly characteristic examples of the Globigerina formation. Passing from the middle plateau of the Atlantic into the western trough with depths a little over 3,000 fathoms, the red clay returned in all its purity: and our last sounding in 1,420 fathoms before reaching Sombrero, restored the Globigerina ooze with its peculiar associated fauna.

This section shows also the wide extension and the vast geological importance of the red clay formation. The total distance from Teneriffe to Sombrero is about 2,700 miles. Proceeding from east to west, we have

About 80 miles of volcanic mud and sand,
,, 350 ,, Globigerina ooze,
,, 1,050 ,, red clay,
,, 330 ,, Globigerina ooze,
,, 850 ,, red clay,
,, 40 ,, Globigerina ooze;

giving a total of 1,900 miles of red clay to 720 miles of Globigerina ooze."

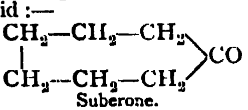
(*To be continued.*)

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for October commences with a paper, by Prof. Roscoe, On a new chloride of uranium. The new compound is the pentachloride UCl_5, obtained by passing chlorine over a heated mixture of any oxide of uranium and charcoal. If the current of chlorine is slow, the substance forms dark needle-shaped crystals with a green metallic lustre and ruby red by transmitted light. When the chlorine is passed rapidly, UCl_5 is formed as a brown powder. The compound decomposes on heating into the tetrachloride and free chlorine.—The next paper is on suberone, by C. Schorlemmer and R. S. Dale. This body is formed by distilling suberic acid with lime according to the equation—

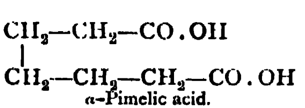
$$2C_8H_{14}O_4 = 2CO_2 + 2H_2O + C_{14}H_{24}O_2.$$

Hexane is produced at the same time, and can be separated by fractional distillation. Pure suberone is a mobile liquid, boiling at 179° to 181°. The molecular formula is $C_7H_{12}O$, and it is oxidised by nitric acid into an acid of the formula $C_7H_{12}O_4$. The authors have examined the barium, calcium, and silver salts of this acid. The new acid has the same composition as the pimelic acid obtained by Hlasiwetz and Grabowsky from camphoric acid, but its properties are quite different, and it has been provisionally named α-pimelic acid. The authors assign the following constitutional formulæ to suberone and α-pimelic acid:—



$$\begin{array}{l} CH_2—CH_2—CH_2 \\ | \\ CH_2—CH_2—CH_2 \end{array} > CO$$

Suberone.



$$\begin{array}{l} CH_2—CH_2—CO.OH \\ | \\ CH_2—CH_2—CH_2—CO.OH \end{array}$$

α-Pimelic acid.

Note on the crystalline forms of meconic and α-pimelic acids, by Dr. C. A. Burghardt.—On the action of earth on organic nitrogen, by E. C. C. Stanford. The experiments were made on mixtures of lean meat with ordinary loam-earth, and the author deduces therefrom the following conclusions:—1. Earth mixed with organic nitrogenous matter is an indifferent dryer, and, except in considerable quantity, a poor deodoriser. 2. That the mixtures continuously lose nitrogen to about the extent of 73 per cent. in five months. 3. That the loss is perhaps wholly due to decay, the nitrogen being probably evolved as ammonia. 4. That in such mixtures the earth does not act as an oxidiser, no nitrification taking place.—The remainder of the journal is devoted to abstracts from foreign periodicals, many of which have been already noticed in these columns.

Gazzetta Chimica Italiana, fascicolo vi., vii., and viii., October.—This part begins with a long and valuable paper by W. Koerner, entitled "Studies of the Isomerism of the bodies known as Aromatic Substances with six Carbon Atoms." This research has led the author to study the action of nitric acid on acetanilide giving rise to the formation of nitro-acetanilide, which is converted by potassium hydrate into a mixture of ortho- and meta-nitroaniline. Para-nitroaniline from ordinary dinitro-benzene is next treated of, then the reduction of meta-nitroaniline. Iodobenzene acted upon by nitric acid yields ortho- and meta-iodo-nitrobenzene, the first of which was converted by the action of nitro-sulphuric acid into a dinitro derivative, which, on treatment with a dilute solution of potassium hydrate, is converted into the potassium salt of ordinary dinitrophenic acid, and by the action of alcoholic ammonia into ordinary dinitro-aniline. From these reactions the author concludes that this dinitro-iodobenzene has the structural formula 1 : 2 : 4. Dinitro-iodobenzene from meta-nitro-iodobenzene has been prepared and proved to be identical with the foregoing body; at the same time a small quantity of a second dinitro compound is produced, which the author considers as the iodide of the β dinitrophenol of Huebner and Werner. The dinitro-aniline from this body has been prepared, and the constitution 1 : 2 : 6 is assigned to it. The author next enters into the consideration of this β dinitrophenol—a table comparing the fusion points of this body and its derivatives with those of the α compounds is given. The brominated derivatives of the aniline have been examined, and the constitution 1 : 2 : 4 assigned to the dibromo-aniline. A large section is next devoted to the three isomeric dibromo-benzenes; dichlorobenzene is also considered, and the three monobromo-toluenes. The action of bromine on the isomeric nitro-anilines has been studied, and constitutional formulæ are assigned to the resulting compounds. The author then goes on to consider the preparation of the new dinitrobenzene and the products of its transformations. The mono-nitro compound has been submitted to a similar study, and likewise the mono-nitro derivatives of the dichloro-, chloro-bromo-, chloro-iodo-, bromo-iodo-, and di-iodo-benzene. The next section is devoted to the constitution of the principal substitution products of phenol. The isomeric monobromophenols are first treated of, then the following bodies in succession:—dibromo-ortho-nitroanisol, the corresponding meta compound, Laurent's bromodinitrophenol, the dinitrochlorophenol of Dubois, and the corresponding bromo- and iodo compounds; finally, dinitro-para-dibromobenzene, its phenol and aniline. The three isomeric tribromobenzenes are next treated of: nitrotribromobenzene and the products of its decomposition. The constitution of the di-derivatives is discussed, and the present state of our knowledge with respect to the ortho-, para-, and meta- series of the aromatic compounds is well displayed in a series of tables. The remainder of this paper, of which the foregoing is but an imperfect outline, is entirely devoted to theoretical considerations. —The next paper is a preliminary note on the action of hydriodic acid on santonic acid, by S. Cannizzaro and D. Amato.—This is followed by a paper by the same authors on metasantonine, to which the formula $C_{15}H_{18}O_3$ is assigned.—Quantitative determination of the atomic group C_2H_3O contained in acetyl substitution products, by Fausto Sestini.—On the action of bromine on anhydrous chloral, by A. Oglialoro.—Allylate of chloral, by the same author.—Transformation of benzamide into benzoic aldehyde and alcohol, by Prof. J. Guareschi.—Action of sulphur on calcium carbonate, by E. Pollacci.—On the production of ozone by means of the electric discharge, by C. Giannetti and A. Volta. —On the necessity for searching for phosphorus in the urine in cases of poisoning, by F. Selmi. The same author contributes a paper on milk.—The concluding paper is by M. Mercadante, on the behaviour of tannic acid when used in agriculture.—The part concludes with notices of current foreign work in technical chemistry.

Bulletin de la Société d'Anthropologie de Paris, tome neuvième.—M. Dareste, in reply to the discussion which his paper on double or twin monsters (as given in a former number) had called forth, explains the nature of the observations on which his deductions were based. It would appear that after submitting nearly 8,000 hens' eggs to the process of artificial incubation, he obtained nearly 4,000 anomalies or monstrosities, but of these only about thirty were double embryos or twin monstrosities. A similar result has been observed in the case of osseous fishes; and Jacobi, who was the first to discover (in the course of the last century) the mechanism of fecundation among these fishes, had noted the proportion of twin monsters in fishes' eggs. His observations and those of Lereboullet coincide with the result obtained by M. Dareste, that while external conditions may often determine the formation of simple monsters, they are absolutely without effect in regard to the evolutions of double monstrosities.—M. M. A. Bertrand, in a communication specially addressed to the Society, has propounded the novel hypothesis that the discovery of the manipulation of metals, as copper, tin, iron, silver, and lead, is due to Oriental peoples, with whom it was far advanced at a period when Europe was still in a state of barbarism. He, moreover, is of opinion that these arts came from a common centre by two channels, viz., the valley of the Dnieper and the valley of the Danube, in the latter of which the semi-barbarous Slavonic tribes still practise these arts very much as they first learned them from their Asiatic neighbours.—M. Hamy considers, in a short paper, the value as a distinctive palæontological character of the bifid condition of the canines in the Smeermaas jaw. He had frequently before noticed a transversal flattening in other fossil canines, and since his examination of the Smeermaas jaw he has found two other examples of this from the Quaternary period.—M. Broca discusses at length the influence of humidity on the form and dimensions of fossil crania, and deduces from his observations the general conclusions that the capacity of crania varies greatly in accordance with the hygrometric condition of their walls; that in drying, after removal from a humid soil, they undergo a considerable retraction, amounting in some instances to fully twenty cubic centimetres; that the walls of fossil crania are hygrometric; and that, consequently, no comparative observations of cranial capacity have any value unless all the crania have been exhumed for a space of many months.

THE August number of the *Bulletin de la Société d'Acclimatation de Paris* opens with a list of the various animals and plants which the society is prepared to lend to its members, with a view to establishing any new or rare forms of animal or vegetable life in different parts of the country. This is an organisation which might usefully be adopted in England.—A paper by M. B. Rico shows how varieties of Salmonidæ may be kept in enclosed waters, and points out—as Mr. Buckland has proved in England —that salmon and trout will keep in good condition in enclosed places with a good supply of food and of running water.—Dr. Turrel, in a paper entitled "Les Oiseaux et les Insectes," combats the theory of M. Perris that birds have very little effect in checking the increase of insects. He thinks that to the indiscriminate slaughter of small birds may be traced, to a certain extent, the spread of the Phylloxera.—Mr. R. Trimen contributes an interesting paper on the animals and useful plants of the Cape of Good Hope, from which it appears that there are no mammalia indigenous to South Africa which have been employed as beasts of burden; but the colony is rich in edible animals and valuable birds.—M. Cabonnier announces the arrival from India of several specimens of three varieties of fish never hitherto brought to Europe—the *Anabas scandens* or Climbing Perch, the Telescope Fish, and the Gourami.—The Phylloxera is the object of various notes and suggestions, with the view of providing some means of rresting its progress.

Reale Istituto Lombardo, Rendiconti, vol. 7, fasc. viii.—Prof. Giovanni Cantoni contributes a note, "Researches on Heterogenesis." Ten years ago the Academy appointed a committee to investigate spontaneous generation, which from time to time reports its experiments. Dr. Grassi and Dr. Macagno, at Asti, have devoted themselves to the question of vinous fermentation. With saccharine solutions and new wine, they obtained the cryptogams characteristic of vinous fermentation. A certain number appeared in flasks hermetically sealed and heated for half an hour to 100°, and some occurred in flasks containing air filtered through cotton-wool, and washed both in sulphuric acid and an alkaline solution. These observers affirm that raising the temperature of wine does not destroy Pasteur's germs, owing to a special combination between the liquid and the small quantity of free oxygen remaining in the sealed vessel.—The next paper, On the limits of electrical resistance in non-conductors, is by the same author.—Prof. Giovanni Zoga gives an account of the Anatomical Museum of Pavia, which contains 638 preparations, of which 38 are complete skeletons, 26 male and 12 female, varying in age from the fœtus of two months to 101 years. Most of them are Italian, though two are German, one American, one Moor, and one Egyptian. There are 200 skulls and 400 portions of different skeletons. Of these skulls only 46 are females, and although the greater part are Italian, they include representatives of the various nations of Europe, Asia, and America, and of different social grades. The author mentions peculiarities seen in the several bones, and gives measurements of the skulls.—The last article is by Dr. Guido Grassi, and is devoted to the explanation of a new reflecting balance. This is a common balance with a reflector fixed above the index. He details experiments to show the way in which it may be used, and its advantages in the physical laboratory, since the fiftieth part of a milligramme can be estimated by it quicker than by the ordinary method.

SOCIETIES AND ACADEMIES

London

Physical Society, Nov. 21.—Dr. J. H. Gladstone, F.R.S., president, in the chair.—Prof. Macleod described a simple arrangement he had devised for showing internal resistance in battery cells. Two tubes about half a metre long, one of which is about twice the diameter of the other, are closed at their lower ends with corks. On the corks and within the tubes rest two discs of platinum foil connected with binding screws by platinum wires passing through the corks. The plates are covered with chloride of silver and the tubes are filled with a solution of chloride of zinc. Each tube is provided with a disc of amalgamated zinc soldered to a long insulated copper wire. The discs are cut so that they nearly fit the tubes, one being exactly double the diameter of the other, and therefore exposing four times the surface to the action of the liquid. On connecting the terminals with a galvanometer, the current will be found to increase as the distance between the zinc and platinum plates is diminished by lowering the zinc plate into the tube. In order to obtain the same deflection of the galvanometer by the narrow cell, the distance between the plates must be one-fourth those of the larger ones. The apparatus may also be used to show that opposed cells of the same kind will not produce a current. For this purpose the platinum plates are connected together and the two zinc plates joined to the galvanometer. No current will flow, whatever the distance between the plates.—Mr. James Baillie Hamilton, of University College, Oxford, made a communication on the application of wind to stringed instruments. Mr. Hamilton commenced with a short history of the efforts which had been made to bring the Eolian harp under human control, and explained how he himself had taken up the matter from Mr. John Farmer on leaving Harrow School. Mr. Farmer had succeeded in getting wind to do the work of a bow upon a string by attaching a reed to the end of it, forming thus a compound string from which a few notes of great beauty could be obtained. Mr. Hamilton, in attempting to complete a perfect instrument, soon found he had undertaken an almost impossible task, from difficulties which he explained to the Society. Failing to obtain advice or assistance, either from scientific men or from the musical instrument makers, he was once more thrown upon his own resources, and, conscious both of his responsibility and difficulties, resolved to leave for a time his university career, and to investigate to the uttermost a matter on which no information could be there obtained. The results of his investigations were then shown to the Society. After two years of labour, Mr. Hamilton had not only gained experience sufficient to perform what he had undertaken, but had also discovered that by a different mode of employing the same material, *i.e.* a string and a reed, he could secure for a string the advantages it afforded by an organ-pipe in addition to those which it already possessed. Showing a pianoforte string on a sound-board, he said: "Such strings already possess certain advantages; first, simplicity of reinforcement by a common sound-board; second, economy of space; third, blending of tone; and fourth, sympathy. Can I also secure for this string the advantages of an organ-pipe—namely, first, special reinforcement; second, volume of tone; third, choice of quality; and fourth, sustained sound?" Accordingly, an open diapason pipe was proposed for imitation, and, to the general surprise, the string was made to exactly imitate it in all these respects. Another string was next sounded, representing the note of the largest organ-pipe in use, in conjunction with other notes, satisfying the hearers that not only could a string do all the work of an organ-pipe in giving volume and sweetness to the note reinforced, but could afford the exquisite sympathetic and blending power hitherto peculiar to strings. Such notes were also sounded seven octaves apart. The reinforcement corresponding to the pipe was secured by the utilisation of a node which cut off from the string a segment corresponding to the note reinforced, presenting to all appearance the phenomenon of an organ built by nature out of a string. This node being a source of motion, is also utilised for gaining quickness of speech, since a cord, acting as a damper and stretched across the nodal line of a series of strings, serves to communicate instantaneous sound from key to key. Another invention of Mr. Hamilton's was a string which could not be put out of tune, to the great surprise of those who attempted to do so. He also exhibited a new pianoforte string, which by its purity and volume of tone showed that the results of a grand pianoforte could be obtained in a cottage instrument. Mr. Hamilton having satisfactorily answered several questions respecting possible objections, concluded by reminding the Society that it was in attempting faithfully to carry out the designs of another man that he was now in a position not only to perform what he had undertaken, but had also been permitted to bring into use a simpler, purer, and grander source of sound than had been contemplated when he laid his hand to a task which he was still engaged in perfecting.

Anthropological Institute, Nov. 24.—Prof. Busk, F.R.S., president, in the chair.—Col. Lane Fox exhibited and described specimens of stone implements, bows, arrows, and blowpipes from San José, Costa Rica. Mr. Charlesworth exhibited characteristic figures, carved in amalgam by Mexican miners, and a chaplet of gold and silver coins as worn by the women of Nazareth.—A brief paper by the late Mr. Cotesworth was read, On ruins in the neighbourhood of Palmyra; with Notes on some skulls found therein, by the President. The ruins described were groups of towers and tombs lying north and south of the Kuryelein road on the hills facing the castle. In one of these towers were discovered many skulls and other human remains, some of which were exhibited on the table. The date of their deposition could not, in the opinion of the author, be less than 1,800 to 2,000 years ago. There were also large underground tombs showing the same arrangements as in the towers. An examination of the remains by the President showed that they belonged to individuals of a dolichocephalic race of large rather than small stature, but by no means gigantic. A short time since Capt. Burton had forwarded skulls to the Institute presenting the same characteristics as the specimens under consideration.—Mr. W. Bollaert contributed Notes on some Peruvian antiquities, and exhibited a series of drawings and photographs in illustration, which he gave to the Institute.

Manchester

Literary and Philosophical Society, Nov. 17.—Edward Schunck, F.R.S., president, in the chair.—Some remarks on Dalton's first table of atomic weights, by Prof. Henry E. Roscoe, F.R.S. This has already appeared in NATURE, vol. xi. p. 52.—Action of light on certain vanadium compounds, by Mr. James Gibbons.—On basic calcium chloride, by Harry Grimshaw, F.C.S.—On the structure of Stigmaria, by Prof. W. C. Williamson, F.R.S., which we hope to give next week.

Philadelphia

Academy of Natural Sciences, July 21.—Dr. Ruschenberger, president, in the chair.—Prof. Persifor Frazer, jun., described a coal-cutting machine, designed by Mr. James Brown, of Brazil, Indiana. It consists of a steel or iron wheel, set in a frame, connected with the pneumatic engine, which runs in rails laid parallel to the face of the heading, which in this case may be several hundred yards long. On the outer periphery of this wheel are arranged twenty or thirty triangular-shaped pieces of steel, united with it at one of their apices by a pin. In the middle of the opposite side, which is curved, are firmly-fixed chilled-steel teeth, which set themselves by friction against the coal to the proper position for cutting, as the wheel is rotated to the right or left. The motion is imparted by means of a small-toothed wheel which moves in rack-work on the under-surface of the wheel.

July 28.—Dr. Ruschenberger, president, in the chair.—On report of the committees to which they had been referred, the following papers were ordered to be published:—Description of a new species of Helix, by James Lewis, M.D.—On some Batrachia and Nematognathi, brought from the Upper Amazon by Prof. Orton, by Edward D. Cope.—Notes on American Lepidoptera, with descriptions of twenty-one new species, by Aug. R. Grote.—Determination of the Species of Moths figured in the "Natural History of New York," by Aug. R. Grote, A.M.

Aug. 4.—Dr. Ruschenberger, president, in the chair.—Mr. Thomas Meehan exhibited some branches of *Acer Pennsylvanicum*, Lin. (*A. striatum*, Lamb), which had a remarkable system of dimorphic foliage. The first pair of leaves developed after the bursting of the bud in the spring, were larger and more perfectly developed than any subsequent ones. The next pair were usually lancelinear. Occasionally there was a tendency to the production of a pair of lobes, but usually the margins were entire or sparsely serrulated. The third and subsequent pairs of leaves partook of the form of the first pair, though seldom so large. It was worthy of remark, that in plants with alternate leaves, the leaves with their axial buds were generally about the same size. In some few instances there were variations in the size, especially in the ⅓ arrangement of the leaves on the stem. In opposite leaved plants the rule was the other way; one bud or one leaf, either in the blade or petiole, being larger or longer than the other. In the maples this was especially the case. At times the petioles in some cases would be not more than half the length of the opposite. He had found this especial peculiarity, however, in no other species but *A. Pennsylvanicum* that he had been able to examine, which included most in common cultivation. It might be in *A. spicatum*, Lam., which he had not been able to examine this season, and which he supposed to be but a variety of *A. Pennslyvanicum.*

Aug. 25.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy exhibited a living specimen of the freshwater ciliated polyp, formerly described by him under the name of *Pectinatella magnifica.* Pectinatella is by far the largest of all the known freshwater ciliated polyps, and, indeed, is not surpassed by any of the marine forms known to us. It has not been determined whether the huge Pectinatella colonies start each from a single individual, or are the result of the confluence of a number of small colonies. On the approach of winter the colonies die and undergo decomposition, in which process the remarkable winter eggs or statoblasts are liberated. These are provided with anchor-like spines, by which, as in the case of the eggs of skates and sharks, they become attached to various fixed bodies. In examining various common animals of our household, Prof. Leidy had found a thread-worm infesting the common house-fly. The worm is from a line to the tenth of an inch long, and lives in the proboscis of the fly. It was found in numbers from one to three in about one fly in five. The parasite was first discovered in the house-fly of India, by the English naturalist, Mr. H. J. Carter, who described it under the name of *Filaria muscæ*, and suggested the opinion that it might be the source of the Guinea worm, *Filara medinensis*, in man. Mr. Carter states that he found from two to twenty of the worms in one fly of three. Dr. Diesing referred the parasite to a new genus with the name of *Habronema muscæ.* The singular position in which the worm lives suggests the many unsuspected places we have to search to find the parents or offspring of our own parasites.

PARIS

Academy of Sciences, Nov. 16.—M. Bertrand in the chair.—The following papers were read:—On a new class of organic compounds, the carbonyls, and on the true function of ordinary camphor, by M. Berthelot. The author classes as carbonyls the three bodies, ordinary camphor, oxide of allylene, and diphenylacetone.—Action of heat on ordinary aldehyde, by M. Berthelot.—On the carpellary theory according to the Liliaceæ and the Melanthaceæ, by M. A. Trécul.—On wounds from trepanning and their dressing, by M. C. Sédillot.—Observations on the November shooting stars, by M. Leverrier.—On the age of the Pyrenean red sandstone and relationship to the Saint-Béat statuary marble, by M. A. Leymerie.—On electric induction, by M. P. Volpicelli.—Action exercised by an electro-magnet on the spectra of rarefied gases traversed by the electric discharge, by M. J. Chautard. The author has hitherto examined only the spectra of metalloids. The magnet appears to influence the number, position, fineness, &c., of the spectral lines in a special manner for each element.—Note on magnetism and on a new exploding fuse, by M. Trève.—On the circulatory system of the Echinidæ, by M. Edm. Perrier.—Note on the manufacture of paper from *gombo* (*Hibiscus esculentus*), and on the industrial uses of this plant, by M. Ed. Landrin.—On the relationship existing between the chemical composition of the air in the swim-bladder and the depth at which the fish are taken, by M. A. Moreau.—Unwholesomeness of the Seine in August, September, and October, 1874, by M. Boudet.—Method pursued in searching for the most efficacious substance for resisting Phylloxera at the viticultural station of Cognac, by M. Max Cornu.—Effects produced by the first frosts on the phylloxerised vines in the vicinity of Cognac, by M. Maurice Girard.—A despatch was read from the French Minister at Pekin, and a letter from M. Fleuriais, announcing the safe arrival and installation of the Transit of Venus Expedition in that city.—On two points in the theory of substitutions, by M. C. Jordan.—On fluorene, by M. Ph. Barbier. The formula for this hydrocarbon is $C_{26}H_{10}$. The author has examined many of its derivatives.—On the marsupium of the eye of birds, by MM. J. André and Beauregard.—New method for the antiseptic occlusion of wounds, by M. Sarazin.—On the mutability of microscopic germs and on the passive function of the organisms classed as *ferments*, by M. J. Duval.—The carboniferous limestone soil of the Pyrenees, by M. Henri Magnan.—The shooting stars of November 1874, by M. Chapelas.

Nov. 23.—M. Cl. Bernard in the chair.—The following papers were read:—Meridional observations of the minor planets made at Greenwich Observatory (forwarded by Sir G. B. Airy, Astronomer Royal) and at the Observatory of Paris during the third quarter of the year 1874, communicated by M. Leverrier.—M. H. A. Weddell communicated a botanical note on the algolichenic theory.—Note on the gum-bearing Acacia of Tunis, by M. Doûmet-Adanson.—On new improvements in magneto-electric machines, by M. Z. T. Gramme.—On the saccharine matter contained in mushrooms, by M. A. Müntz.—Effects of potassium sulphocarbonate on Phylloxera, by M. Mouillefert.—M. Max Cornu presented a paper containing the continuation of his researches for the most efficacious substance for the destruction of Phylloxera.—Experiments made on branches of vine immersed in water containing various substances in solution, by M. A. Baudrimont.—Facts relating to Phylloxera and to the submersion of vines and cereals; application of M. Naudin's process to vines that cannot be submerged, by M. G. Grimaud.—On the stability of the equilibrium of a heavy body resting on a curved support, by M. C. Jordan.—Influence of temperature on the coefficient of capillary flowing of liquids, by M. A. Gueront.—On the product formed by the addition of hypochlorous acid to propylene, by M. L. Henry.—On the Actiniæ of the oceanic coasts of France, by M. P. Fischer.—New researches on the organogenesis of *Lophospermum erubens*, by M. Frémineau.—M. E. Duchemin communicated a note concerning the invention of the circular compass.—During the meeting the perpetual secretary announced to the Academy the safe arrival at Sydney of MM. André and Angot, the members of the Transit of Venus Expedition who are to observe this phenomenon from Noumea.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—Report of Newcastle-on-Tyne Chemical Society.—The Aërial World: G. Hartwig (Longmans).—Transits of Venus: R. A. Proctor, B.A. (Longmans).—Descent of Man (New Edition): Charles Darwin, M.A., F.R.S. (J. Murray).—Transactions of the Institute of Engineers and Shipbuilders in Scotland. Report on Safety Valves.—Chambers's Information for the People (W. and R. Chambers).—The Origin of Civilisation and the Primitive Condition of Man: Sir John Lubbock, Bart., M.P., F.R.S. (Longmans).—Elements of Embryology: M. Foster, M.A., M.D., F.R.S., and F. M. Balfour, B.A. (Macmillan and Co.)

AMERICAN.—Relation between the Barometric Gradient and the Velocity of the Wind: Wm. Ferrel, A.M. (Washington, U.S.)—Complete Works of Count Rumford, vol. iii. (Boston, U.S.)—Proceedings of the American Society of Arts and Science (John Wilson, Boston).—Proceedings of the American Philosophical Society (Philadelphia).—Annotated List of Birds of Utah: H. W. Henshaw (Salem, U.S.)—Report of Explorations of 1873 of the Colorado of the West: Prof. J. W. Powell (Washington).—Synopsis of the Flora of Colorado: T. C. Porter (Washington).

FOREIGN.—Correspondenzblatt des Naturforscher-Vereins zu Riga.—Observacions magneticas y Meteorologicas (Havana, Cuba).

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DIARY OF SOCIETIES.

LONDON

THURSDAY, DECEMBER 3.

LINNEAN SOCIETY, at 8.—Observations on Bees and Wasps: Sir John Lubbock, Bart., F.R.S.—On the Classification of Animals: Prof. Huxley, F.R.S.

CHEMICAL SOCIETY, at 8.—On the Colour of Cupric Chloride: W. N. Hartley.—On the Formulæ of the Alums: S. Lupton.

FRIDAY, DECEMBER 4.

GEOLOGISTS' ASSOCIATION, at 8.—On the Conditions which determine the presence or absence of Animal Life on the Deep-Sea Bottom: Dr. W. B. Carpenter, F.R.S.

SATURDAY, DECEMBER 5.

PHYSICAL SOCIETY, at 3.—On a Strophometer: T. Hearson.—On a method of demonstrating the Expansion of Solids: Prof. G. C. Foster.—On the Electrolysis of certain Metallic Salts: Dr. J. H. Gladstone and A. Tribe.

MONDAY, DECEMBER 7.

ENTOMOLOGICAL SOCIETY, at 7.

ROYAL INSTITUTION, at 2.—General Monthly Meeting.

SOCIETY OF ARTS, at 8.—Cantor Lecture; Alcohol, its Action and Use: Dr. B. W. Richardson, F.R.S.

TUESDAY, DECEMBER 8.

PHOTOGRAPHIC SOCIETY, at 8.

ANTHROPOLOGICAL INSTITUTE, at 8.—Notes on some Tumuli and Stone Circles, near Castleton, Derbyshire: Rooke Pennington, LL.D.—Some account of a Leaf wearing Tribe on the Western Coast of India: M. J. Walhouse.—Further notes on the Stone Monuments of the Khasi Hills: Major Godwin-Austen.

WEST LONDON SCIENTIFIC ASSOCIATION, at 8.—Physical Geography of the Ocean: Dr. J. Foulerton.

METROPOLITAN SCIENTIFIC ASSOCIATION, at 7.

ATHENÆUM LITERARY AND SCIENTIFIC SOCIETY, at 8.—The Life of the Coal Period: Prof. Morris.

WEDNESDAY, DECEMBER 9.

SOCIETY OF ARTS, at 8.—The Protection of Buildings from Lightning: Dr. R. J. Mann.

INSTITUTION OF CIVIL ENGINEERS, at 8.

THURSDAY, DECEMBER 10.

MATHEMATICAL SOCIETY, at 8.—Two Letters from M. Mannheim on Three and Seven Bar Motion. Communicated by J. J. Sylvester, F.R.S.—On the Potentials of Polygons and Polyhedra: Prof. Cayley, F.R.S.

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THURSDAY, DECEMBER 3

GEOLOGICAL SOCIETY, at 8.—On Phenomena of Weather Action and Glaciation exhibited by the Alps of Switzerland and Savoy: Ralph Richardson.—On the different convulsions which the Earth's Crust has undergone since the deposition of the Old Red Sandstone: G. H. M. Binning Horne.

LEEDS

MONDAY, DECEMBER 7.

GEOLOGICAL ASSOCIATION, at 8.—The Antiquity of Man: Dr. H. A. Allbutt.

TUESDAY, DECEMBER 8.

NATURALISTS' FIELD CLUB, at 8.—Council Meeting.

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Three Lectures, to be further announced, March 1st, 8th, 15th.
"The Classification of Plants," April 5th, 12th, 19th, 26th, by Professor BENTLEY, F.L.S.

The following COURSE will be delivered on MONDAYS and THURSDAYS, at Five p.m
"The Life History of Plants and Animals chemically considered," Dec. 21st, 28th, 31st, Jan. 4th, 11th, 18th, by Professor ARMSTRONG, F.C.S.

The following Lecture will be delivered on WEDNESDAY, at 4 30 p.m.
"British Wild Flowers considered in Relation to Insects," Jan. 6th, by Sir J. LUBBOCK, Bart., M.P. F.R.S.

The following will be delivered on THURSDAYS, at Seven p.m.
"The Early Inhabitants of England," Jan. 14th, 21st, by Professor ROLLESTON, F.R.S.
"The Grotesque in Indian Art—Modern French Art," Feb. 4th, 11th, by G G. ZERFFI, Ph D.
"The Physiology of Sleep," Feb. 25th, by Dr. B. W. RICHARDSON, F.R.S.
Two Lectures, to be further announced, March 4th, 11th.
"The History and Use of the English Language," April 1st, 8th, 15th, 22nd, 29th, May 6th, by E. A. FREEMAN, Hon. D.C.L.
The Inner Thought of Shakspeare's Plays," May 13th, 20th, 27th, by Professor MORLEY.

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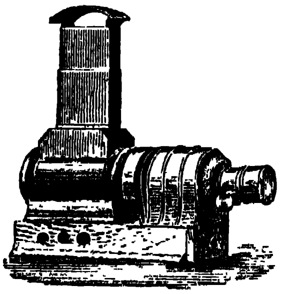

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*ON THE CLASSIFICATION OF THE ANIMAL KINGDOM**

LINNÆUS defines the object of classification as follows:—"Methodus, anima scientiæ, indigitat, primo intuitu, quodcunque corpus naturale, ut hoc corpus dicat proprium suum nomen, et hoc nomen quæcumque de nominato corpore beneficio seculi innotuere, ut sic in summa confusione rerum apparenti, summus conspiciatur Naturæ ordo." (*Systema Naturæ*, ed. 12, p. 13.)

With the same general conception of classificatory method as Linnæus, Cuvier saw the importance of an exhaustive analysis of the adult structure of animals, and his classification is an attempt to enunciate the facts of structure thus determined, in a series of propositions, of which the most general constitute the definitions of the largest, and the most special, the definitions of the smallest, groups.

Von Baer showed that our knowledge of animal structure is imperfect unless we know the developmental stages through which that structure has passed; and since the publication of his "Entwickelungs-Geschichte der Thiere," no philosophical naturalist has neglected embryological facts in forming a classification.

Darwin, by laying a novel and solid foundation for the theory of Evolution, introduced a new element into Taxonomy. If a species, like an individual, is the product of a process of development, its mode of evolution must be taken into account in determining its likeness or unlikeness to other species; and thus "phylogeny" becomes not less important than embryogeny to the taxonomist. But while the logical value of phylogeny must be fully admitted, it is to be recollected that, in the present state of science, absolutely nothing is positively known respecting the phylogeny of any of the larger groups of animals. Valuable and important as phylogenic speculations are, as guides to, and suggestions of, investigation, they are pure hypotheses incapable of any objective test; and there is no little danger of introducing confusion into science by mixing up such hypotheses with Taxonomy, which should be a precise and logical arrangement of verifiable facts.

The present essay is an attempt to classify the known facts of animal structure, including the development of that structure, without reference to phylogeny, and, therefore, to form a classification of the animal kingdom, which will hold good however much phylogenic speculations may vary.

Animals are primarily divisible into those in which the body is not differentiated into histogenetic cells (PROTOZOA), and those in which the body becomes differentiated into such cells (METAZOA of Hæckel).

I.—The PROTOZOA are again divisible into two groups: 1. the Monera (Hæckel), in which the body contains no nucleus; and 2. the Endoplastica, in which the body contains one or more nuclei. Among these, the *Infusoria ciliata* and *flagellata* (*Noctiluca*, e.g.), while not forsaking the general type of the single cell, attain a considerable complexity of organisation, presenting a parallel to what happens among the unicellular Fungi and Algæ (e.g., *Mucor*, *Vaucheria*, *Caulerpa*).

II.—The METAZOA are distinguishable, in the first place, into those which develop an alimentary cavity—a process which is accompanied by the differentiation of the body wall into, at fewest, two layers, an epiblast and a hypoblast (*Gastreæ* of Hæckel), and those in which no alimentary cavity is ever formed.

Among the Gastreæ, there are some in which the gastrula, or primitive sac with a double wall open at one end, retains this primitive opening throughout life—as the egestive aperture; numerous ingestive apertures being developed in the lateral walls of the gastrula—whence these may be termed *Polystomata*. This group comprehends the *Spongida* or *Porifera*. All other Gastreæ are *Monostomata*, that is to say, the gastrula develops but one ingestive aperture. The case of compound organisms in which new gastrulæ are produced by gemmation is of course not a real exception to this rule.

In some Monostomata the primitive aperture becomes the permanent mouth of the animal (*Archæostomata*).

This division includes two groups, the members of each of which respectively are very closely allied:—1. The Cœlenterata. 2. The Scolecimorpha. Under the latter head are included the *Turbellaria*, the *Nematoidea*, the *Trematoda*, the *Hirudinea*, the *Oligochæta*, and probably the *Rotifera* and *Gephyrea*.

In all the other Monostomata the primitive opening of the gastrula, whatever its fate, does not become the mouth, but the latter is produced by a secondary perforation of the body wall. In these *Deuterostomata* there is a perivisceral cavity distinct from the alimentary canal, but this perivisceral cavity is produced in different ways.

1. A perivisceral cavity is formed by diverticula of the alimentary canal, which become shut off from the latter (*Enterocœla*).

The researches of Alexander Agassiz and of Metschnikoff have shown that, not only the ambulacral vessels, but the perivisceral cavity of the *Echinodermata* are produced in this manner; a fact which may be interpreted as indicating an affinity with the Cœlenterates (though it must not be forgotten that the dendrocœle *Turbellaria* and many *Trematoda* are truly "cœlenterate"), but does not in the least interfere with the fundamental resemblance of these animals to the worms.

Kowalewsky has shown that the perivisceral cavity of the anomalous *Sagitta* is formed in the same way, and the researches of Metschnikoff appear to indicate that something of the same kind takes place in *Balanoglossus*.

2. A perivisceral cavity is formed by the splitting of the mesoblast (*Schizocœla*).

This appears to be the case in all ordinary *Mollusca*, in all the polychætous *Annelida*, of which the *Mollusca* are little more than oligomerous modifications, and in all the *Arthropoda*.

It remains to be seen whether the *Brachiopoda* and the *Polyzoa* belong to this or the preceding division.

3. A perivisceral cavity is formed neither from diverticula of the alimentary canal nor by the splitting of the mesoblast, but by an outgrowth or invagination of the outer wall of the body (*Epicœla*).

The *Tunicata* are in this case, the atrial cavity in them being formed by invagination of the epiblast.

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* Paper read at the Linnæan Society, Dec. 4, 1874, by Prof. Huxley, Sec. R.S.

Amphioxus, which so closely resembles an Ascidian in its development, has a perivisceral cavity which essentially corresponds with the atrium of the Ascidian, though it is formed in a somewhat different manner. One of the most striking peculiarities in the structure of *Amphioxus* is the fact that the body wall (which obviously answers to the somatopleure of one of the higher *Vertebrata*, and incloses a "pleuro-peritoneal" cavity, in the walls of which the generative organs are developed) covers the branchial apertures, so that the latter open into the "pleuro-peritoneal" cavity. This occurs in no other vertebrated animal. Kowalewsky has proved that this very exceptional structure results from the development of the somatopleure as a lamina which grows out from the sides of the body and eventually becomes united with its fellow in the middle ventral line, leaving only the so-called "respiratory pore" open. Stieda has mentioned the existence of the raphé in the position of the line of union in the adult animal. Rathke described two "abdominal canals" in *Amphioxus;* and Johannes Müller, and more recently Stieda, have described and figured these canals. However, Rathke's canals have no existence, and what have been taken for them are simply passages or semi-canals between the proper ventral wall of the abdomen and the incurved edges of two ridges developed at the junction of the ventral with the lateral faces of the body, which extend from behind the abdominal pore where they nearly meet, to the sides of the mouth. Doubtless, the ova which Kowalewsky saw pass out of the mouth, had entered into these semi-canals when they left the body by the abdominal pore, and were conveyed by them to the oral region. The ventral integument, between the ventrolateral laminæ, is folded, as Stieda has indicated, into numerous close-set, longitudinal plaits which have been mistaken for muscular fibres, and the grooves between these plaits are occupied by epidermic cells, so that, in transverse section, the interspaces between the plaits have the appearance of glandular cœca. This plaited organ appears to represent the Wolffian duct of the higher *Vertebrata*, which, in accordance with the generally embryonic character of *Amphioxus*, retains its primitive form of an open groove. The somatopleure of *Amphioxus* therefore resembles that of ordinary *Vertebrata* in giving rise to a Wolffian duct by invagination of its inner surface. But the Wolffian duct does not become converted into a tube, and its dorsal or axial wall unites with its fellow in the raphé of the ventral boundary of the perivisceral cavity.

In all the higher *Vertebrata* of which the development has yet been traced, the "pleuro-peritoneal" or perivisceral cavity arises by an apparent splitting of the mesoblast, which splitting, however, does not extend beyond the hinder portion of the branchial region. But, in many *Vertebrata*, (*e.g.*, *Holocephali*, *Ganoidei*, *Teleostei*, *Amphibia*) a process of the integument grows out from the region of the hyoidean arch, and forms an operculum covering the gill-cleft. In the frog, as is well known, this opercular membrane is very large, and unites with the body wall posteriorly, leaving only a "respiratory pore" on the left side, during the later periods of the tadpole's life. Here is a structure homologous with the splanchnopleure of *Amphioxus;* while, in the thoraco-abdominal region, the splanchnopleure appears to arise by splitting of the mesoblast. Considering what takes place in *Amphioxus*, the question arises whether the "splitting" of the mesoblast in the *Vertebrata* may not have a different meaning from the apparently similar process in the *Arthropoda*, *Annelida*, and *Mollusca;* and whether the pericardium, pleura, and peritoneum are not parts of the epiblast, as the atrial tunic is of the epiblast of the ascidians. Further investigation must determine this point. In the meanwhile, on the assumption that the "pleuro-peritoneal" cavity of the *Vertebrata* is a virtual involution of the epiblast, the peritoneal aperture of fishes becomes truly homologous with the "respiratory pore" of *Amphioxus;* and the Wolffian ducts and their prolongations, with the Müllerian ducts, are, as Gegenbaur has already suggested, of the same nature as the segmental organs of worms.

The division of METAZOA without an alimentary cavity is established provisionally, for the *Cestoidea* and *Acanthocephala*, in which no trace of a digestive cavity has ever been detected. It is quite possible that the ordinary view that these are Gastreæ modified by parasitism is correct. On the other hand, the cases of the Nematoid worms and of the *Trematoda* show that the most complete parasitism does not necessarily involve the abortion of the alimentary cavity, and it must be admitted to be possible that a primitive Gregariniform parasite might become multicellular and might develop reproductive and other organs, without finding any advantage in an alimentary canal. A purely objective classification will recognise both these possibilities and leave the question open.

THE "TIMES" ON THE IMPORTANCE OF SCIENTIFIC RESEARCH

[IN an article which appeared in yesterday's *Times*, occasion is taken of the occurrence of the Transit of Venus to point out the great activity now being displayed by foreign nations in the prosecution of abstract scientific inquiries, and the necessity of retaining England's old pre-eminence in this respect. The article is so important as indicating the growing importance which is being attached to research, that we reproduce a great part of it in our own columns, because the considerations urged by the *Times* lead to a conclusion of no uncertain sound. As England has nobly in the past, when she was almost alone, led in the search after abstract scientific truths, it behoves her now that she is by no means alone and has to compete with rivals who have shown by their Transit expeditions and by many other signs what their opinion is on this matter, to more than redouble her old efforts, if she wishes to retain the position she has won by the accumulated work of centuries.—ED. NATURE.]

THE astronomer's point of view is by no means the only one of general interest connected with the recent Transit. We have, first of all, the remarkable spectacle of trained observers of almost all nationalities—observers sent out by England, the United States, France, Germany, Italy, and Holland — distributed among some seventy stations, some of them the most inhospitable islands of the Southern seas, engaged upon one of the most abstract inquiries which can be imagined. The anxiety of the various European and the American Governments to contribute towards the solution of the problem can perhaps best be shown by indicating the stations occupied this morning by the various parties. The English flag floats over the observatories of three parties in the Sandwich Islands, two parties in Kerguelen's Land, one in Rodriguez, one in New Zealand, two in Egypt, and one in India; nor must we omit to mention Lord Lindsay's station in the Mauritius, though his is a private expedition. This is a goodly list, but it is surpassed in its area of distribution by the American expeditions, which occupy Vladivostok in Siberia, Tien-tsin, a station in Japan, and in the Southern seas Kerguelen's Land, the Crozets, Hobart Town, Bluff Harbour (New Zealand), and Chatham Island. France has seven stations—Campbell and St. Paul's Islands, Noumea, Pekin, Yokohama, and Saigon. Russia does not occupy any southern stations, but she makes up for this by observing at no less than thirty stations within her own territory. The German Government has equipped five southern parties, while Holland is represented at Réunion. Italy has a party in Egypt. She was to have been represented by four parties in all; but little is known of her arrangements.

The number of observed Transits has been so few that it is an easy task to contrast the present arrangements with what was done in former times. Horrox, one of the most gifted of English men of science—whose memory, we rejoice to know, will this year be appropriately, if tardily, perpetuated by a tablet in Westminster Abbey—predicted the Transit of 1639 so shortly before he observed it that there was no time, if, indeed, there had been any desire, to send observers from England. When the next Transits occurred in the following century, in the years 1761 and 1769, the expeditions were few. In the former year we had an English expedition to Sumatra and a French one to Pondicherry, neither of which reached its destination; and there was another French expedition to Tobolsk. Observations were made at many places, the unfortunate Le Gentil, the French Envoy to Pondicherry, making his on board ship. In 1769 came the celebrated voyage of Captain (then Lieutenant) Cook, in the *Endeavour*, to Otaheite, on behalf of England. The King of Denmark sent an observer to Lapland; and the French Academy despatched one to California, in addition to Le Gentil. The latter had waited at Pondicherry since 1761, hoping to make up by good fortune in 1769 for his partial want of success in 1761, but the Fates were against him.

It will be seen from this rapid statement that, so far as the number of the *personnel* is concerned, the present expeditions are beyond all precedent. This remark naturally applies much more strongly to the means of observation. Not only do modern telescopes bear the same relation to those used on former occasions as a Woolwich gun does to a smooth-bore musket, but two new instruments of inquiry have been added to the scientific stock-in-trade. This morning, if the weather has been favourable, more than a score of cameras have obtained permanent records of the black spot travelling over the sun's disc at one part or another, or during the whole time of its passage, and if the spectroscope has not been used to record the planet's contact with the sun long before the eye or photographic plate could detect her presence, and again to mark the exact instant at which she parted company with it, it is not the fault of the instrument. But it is not merely to the *personnel* nor to the instruments employed that we wish to draw chief attention, but rather to the indications afforded that the example which England and France have of old set in promoting such inquiries is being followed by other nations, and with a most remarkable vigour and intensity of purpose. Denmark, which took no part in this morning's observations, has been replaced by the United States, Germany, Holland, and Italy, and the part played by these nations, new to this peaceful strife, is most important. The United States lead all the other nations, in respect both of the amount of money which her Government has contributed, and of the discomfort, not to say dangers, of the stations she has chosen in the Southern seas. Posts of importance which were given up as too hopelessly miserable even for enthusiastic English astronomers will be occupied by Americans. The Germans have closely followed England and the United States in this noble competition, and although the sum contributed by the German Government is small compared with the American subsidy, the German observations made this morning in the South seas will be among the most important obtained by all the expeditions. With regard to Italy, also, there are the same signs of scientific enterprise. The spectroscope, which forms no part of the equipment of the English expeditions, was intended by her men of science to be their chief weapon of attack, and as in no country is there such a skilled body of spectroscopists as in Italy, this determination was probably not arrived at on insufficient grounds.

What, then, is the meaning of all this? It is that as the world grows older each nation as it develops, as the United States, Germany, and Italy have of late largely developed, under modern conditions, feels the necessity for taking a continual and a largely increasing share in the promotion of science even in its most abstract forms. It should be a subject of pride for us to know that in this they are but following the example set by England in former centuries, including the days "when George III. was King." If we consider the revolutions effected by science since Capt. Cook's famous expedition to observe the last Transit, we shall not be astonished that the nations are beginning to vie with each other so eagerly in its development. When Cook sailed in 1768, Watt was thirty-two years of age; in the very year of the Transit he introduced the closed cylinder, and so gave us the steam-engine of to-day in its essential point. In the same year the founders of chemistry were in their early prime. Priestley was thirty-six years of age, Cavendish thirty-eight, Black forty-one, and Lavoisier twenty-six; Dalton was three years old. What has not chemistry done for England since their time? Be it always remembered that all the work of these men was of the most abstract kind, and yet that out of it has grown insensibly a large part of England's commercial greatness. Nor is this all. There is another development of science still which must be mentioned, but which is of so recent a date that in 1769 no one whose name is now associated with one of the greatest triumphs of science was born. We refer to those discoveries that have belted our world with the electric wires which to-day, from the most distant parts of our planet's surface, will bring to Europe the results of this morning's work.

It is a proper subject of national pride that the benefits derived by the world from the invention of the steam-engine and the electric telegraph, and from the various applications of chemistry to the industrial arts, have all, until the last few years, radiated from England. We have here the secret of a large part of England's riches and England's strength. But it is useless to hope that the mere knowledge of the acquired facts of science will furnish that new weapon which nations are now adding to the sword to enforce their superiority. The mental soil which produces new ideas for a nation's use can only be cultivated by the discipline of scientific investigation. Further, it cannot be doubted that, as modern civilisation is still further developed, the new ideas which a nation produces and throws into a concrete form will be among the most valuable of its exports, because each nation will work up the old ideas for itself.

AGRICULTURAL EDUCATION

THE application of the law of selection to the production of farm crops and animals offers a certain and wide field for increasing our agricultural wealth. In every department of the farmer's occupation there is great room for improvement if this scientific principle be borne in mind.

It is well known that science has, in our time, thrown extraordinary light on the action of manures. Yet too few of our farmers are guided in their practice by this light. In every district of the United Kingdom farmers apply manures which are either incapable of drawing out the full productive powers of the soil, or comparatively worthless.

Again, it is notorious that the yield of millions of acres of our wet, cold lands could be largely increased by drainage.

There is no branch of agriculture which has progressed so much in modern times as the manufacture of farm implements and machines. Yet, an enlightened and experienced agriculturist who travels through England cannot fail to see an enormous waste of power, arising from the use of unsuitable implements, as well as from ignorance of the elementary principles of mechanical science.

Numerous additional examples could be cited, but it is not necessary. It is enough to state the broad fact that while the foremost of our farmers are the most enlightened in the world, there is a vast number of occupiers of land in Great Britain and Ireland who do not avail themselves of the aids which science is capable of affording them.

To the farmer, as to everybody else, knowledge is power. The increased annual wealth capable of being produced by the application of this power is very considerable. It has been stated by several persons whose opinions on agricultural questions appear to command respect, that the produce of the soil of England could be doubled by improved modes of farming. After having seen from time to time a good deal of English farming, I consider this estimate quite too high; but all thoughtful and experienced persons will concur in the opinion that by the adoption of means which could be called forth, the produce of the soil of Great Britain would soon be increased to an amount equal to the rental of the entire land of the country; that is to say, *farmers could increase the productive power of the soil to the extent of, say, forty millions sterling a year!* They would reap the first fruits of this harvest. In due time the landlords would come in for their share of it in the shape of increased rents; for, as I have often pointed out, it is a law of agricultural progress that every increase in the productiveness of the land, and every rise in the prices of its products, by increasing the competition for land, tend to raise rents.

How can we increase the productiveness of the land? There are many ways in which progress may be effected; but we must seek the solution of the question mainly in education, using the word in its widest sense.

The wealth of farmers depends on their knowledge, skill, and thrift. Of thrift we shall say nothing in this note. Skill is required by both farmers and labourers. It is a plant of slow growth. The navvy acquires it by plodding application. The skill of the high-class agricultural labourer is acquired in the same way. The skill of the high class-farmer, too, is the result of continuous application to business. The skill acquired by one generation is capable of being imparted to, and of being improved upon, by the next. The skill possessed by both agricultural labourers and farmers in England has been thus transmitted from generation to generation, and improved in its transmission, in accordance with a law of development. It would be unfortunate if any circumstances or set of circumstances should interfere with this development. We cannot now discuss this subject; but it may be remarked that one of the features of the present movement in the agricultural labour market which deserves serious attention is, that skilled hands have left many districts. Several very thoughtful English farmers of my acquaintance already complain of want of skill in the young hands who remain at home. In a recent agricultural tour in England I saw evidence of the same state of things. Unless the movement be arrested, English farming will, in all human probability, undergo a change which may be prejudicial to the agricultural interest. What the tendency of that change would be is foreign to the object of this paper, and accordingly I proceed to make a few remarks on the importance of imparting agricultural knowledge.

It has been already affirmed that general knowledge imparts power to every man. This is true in every state of life. It is true in science; it is equally true in the industrial arts. The proposition is supported by an overwhelming mass of evidence. Royal Commissioners, Special Commissioners, and distinguished independent inquirers are all in unison on the question. All our systems of technical education are based on this one leading idea. The whole programme of the Department of Science and Art is based upon it. In the leading cities and towns the rising generation of the manufacturing classes can acquire scientific knowledge which will be of direct use to them in their several pursuits. In the village school scientific truths are imparted which cannot fail to be of use to the trader and artisan.

How different is the case with the farmer! In his education no systematic effort has been made to instil into his mind those elementary scientific truths on which enlightened agricultural practices are based. The result is, that he grows up in complete ignorance of the rudiments of agricultural science.

How is this state of things to be remedied? In other words, how is a suitable amount of agricultural science to be imparted to farmers?

In answering this question it is important to distinguish between ordinary working farmers who receive their education in Primary schools, and farmers who are able to pay for a higher education, such as is afforded in boarding schools and seminaries and other institutions of the same grade.

As regards the first of these two classes, I would say that I see no reason why an adequate amount of agricultural instruction could not be imparted in the primary schools. All that is required is a suitable text-book or two, and such a system of inspection as will ensure that the book shall be read, and all difficult passages explained by the teachers. This simple system of agricultural education has been tried in Ireland for many years. It has laboured under many difficulties; but as it has succeeded admirably wherever it has been fairly tried, I can have no hesitation in recommending it for adoption elsewhere. To those who desire to introduce it into England I would say, before you start, see that you are upon the right rails, and that you use the proper instruments. In a movement of this kind all sorts of people will come in with all sorts of advice; the busiest and most active of these may be ignorant of the A B C of science and of enlightened agricultural practice. Keep clear of these people. If not, you will either fail altogether, or effect little good, like many others who, from time to time, have embarked in agricultural education.

I look to the diffusion of sound notions of the elements of agricultural science in the way pointed out, as the best means of removing prejudice, and of increasing the agricultural produce of the land in the hands of small farmers.

It is by no means so easy to devise, for the wealthier farmers, a system of agricultural education which will be successful. The words "agricultural education" have led to much confusion of thought; and confusion of thought on any subject works mischief. Some persons use these words in a way which would imply that the farmer should have a special system of education peculiar to himself, from the moment he enters school till he leaves it for good. Of course this is not the case, and it is certain that in the case of large farmers we must look more to the effects of a good general education than of special instruction. The first truths of physical science, of chemistry, and natural history should enter into the curriculum of every middle-class school and college in the country. This knowledge will be useful to the student, no matter what his future calling may be. As regards the farmer, it may be remarked that, without a knowledge of mechanics he cannot be in a position to buy implements and machines to the best advantage, or to understand how to apply horse-power and other forces in the most judicious manner. Look, for example, at the loss of power daily caused by ignorance of the elementary principles involved in common draught. Look at the loss entailed on farmers in the simple matter of common gates for want of knowledge of the means of resisting strains, and of other principles equally elementary. It has been shown that in the production of animals and plants very great mistakes are committed for want of knowledge of physiology. This science should, therefore, be taught in all our middle-class colleges and schools attended by farmers. We must not, of course, neglect mathematics, the study of which is the very best training for the mind. If the large farmer be well instructed in all the sciences named, agriculture will keep pace with other pursuits in which scientific knowledge is required. It is in the universal inculcation of this scientific knowledge that I look mainly for progress in the management o large farms. I do not wish to undervalue, and I canno in these papers overlook, special agencies for imparting agricultural knowledge to this class. I refer to agricultura colleges and agricultural schools. Viewing the subject theoretically, one of these institutions would seem to be the most perfect place at which the future farmer could spend a year after leaving school or college, and before he enters into practical work. He could attend lectures and he ought, one would suppose, to be able to see theory reduced to practice.

But after having carefully inquired into the working o these institutions at home and in parts of the Continent I am bound to say that their theoretical value has no been realised in practice. In point of fact, taking them as a whole, their history has been peculiarly unfortunate. I shall refer to this subject more fully hereafter At present it is enough to state that with few exceptions agricultural schools and colleges have failed; and success in the exceptional cases has turned upon the peculiar fitness of the individuals on whom the management has devolved, and who by force of character have produced striking results. A general failure in working out a comprehensive system cannot be accounted fo by the shortcomings of individuals. The failure of an institution here and there, for a time, can often be traced to the inefficiency of the person or persons at the head of them; I have before my mind numerous examples o the kind; but in accordance with a well-known law, suitable men would arise if the demand existed. And why has this law not prevailed in the case of agricultura schools and colleges? The apparent answer is, tha farmers everywhere have not sent their sons to these institutions in sufficient numbers. And why? In answering this question it has been invariably stated tha farmers as a class are slow to do what is for their good to me this off-hand sort of reply has always appeared most unsatisfactory. Farmers, like every other class find out, after a time, what is for their good. Intelligent farmers, like intelligent men in every walk of life study their own interests. Owing to their isolation, or want of daily intercourse, they do not move in the path of progress as rapidly as the manufacturing classes who live in cities and towns, and who are brought into daily intercourse with one another. But when we find farmers standing aloof from any system established with the intention of serving them, we may take it for granted that there is something inherent in the system which requires to be adjusted or is inimical to success. What i this something in the history of agricultural college and schools? For obvious reasons I cannot fully stat my experience on this question; but I can say tha the answer will be partly found in the peculiar stat of farming as a business. Our scientific knowledge of agriculture, even at the present day, is in a very unsettled state. Theories have risen and fallen in a way which has led rent-paying farmers to regard science with indifference and suspicion. We find evidence of this feeling in our daily intercourse with them. To a large extent they are justified by the vagaries of some of the so-called scientists. I see only one feasible remedy for this, and that is the introduction of the necessary quantity of pure science into the education of the farming classes. This cannot be done in an agricultural college or two. It must be done on a national basis; that is, by establishing science classes in every middle-class college and school throughout the length and breadth of the land. And having done this, a few normal schools of agriculture would soon arise to complete and crown the work. If scientific instruction were placed on a national basis, the normal schools would become filled with the best minds in the country. In the absence of such a system an isolated school or college cannot prevent itself from doing mischief in one direction which has escaped attention; I mean, that if the best men do not enter it, inferior men acquire what I may call an artificial brand which enables them to obtain high positions in connection with agricultural industry—for example, as estate agents and managers—to the exclusion of men of superior natural powers, and to the detriment of the national interests. In other words, the natural law of Selection is subverted.

THOMAS BALDWIN

THE SHEEP

The History, Structure, Economy, and Diseases of the Sheep. By W. C. Spooner, M.R.V.C. Third Edition. (London: Lockwood and Co., 1874.)

THROUGHOUT the whole historic period the sheep has been a source of wealth to man. Mutton has been a staple article of human food, and wool one of the staple materials out of which fabrics have been made for human use. At no period in the history of the United Kingdom has the sheep been so much the object of the farmer's solicitude and care as at the present day. A new edition, purporting to be carefully revised and considerably enlarged, of a work exclusively devoted to the animal, from the pen of Mr. W. C. Spooner, V.S., is, therefore, manifestly entitled to attention. Mr. Spooner has written much. To Blackie's "Cyclopædia of Agriculture" he contributed several valuable papers on veterinary subjects. He has written several other thoughtful essays. He is best known as the editor of an edition of White's "Veterinary Art." The work now before us is the one by which he can best be judged as an author. The title of the volume is pretentious. It would lead the reader to expect an exhaustive treatise; but the most superficial examination corrects this impression.

The volume extends to 322 pages. It is divided into three parts. The first part contains eighty-two pages, and is devoted to the history of the several breeds of sheep. The second part treats of the structure and economy of the sheep, and contains 108 pages; and Part III., occupying the remainder of the text, is devoted to the diseases of the animal. With one or two exceptions, the matter is arranged under these three heads. The exceptions are, however, unpleasant and unaccountable. This arises, to some extent, from treating of the structure and "economy" under one general heading. In this part of the work the author treats of breeding and feeding, which, according to his notions, are manifestly embraced in the term "economy." In the historical section of the book a good deal of information is given on the origin of new breeds, and it is to the repetition of some of this in the chapters on breeding, and the influence of ram sales in the second part of the book, that exception may justly be taken. Tautology, in this busy age, is a great fault. In the present instance it is the less pardonable, because it is not necessary, or even intended, to call back the mind to principles previously expounded.

In the account given of the several breeds no principle of classification appears to have been kept in view. The practical value of the facts is not, of course, lessened by this circumstance; but it must be admitted that the value of a book is greatly enhanced to the public by a proper classification and arrangement of its matter. Judged by this standard, Mr. Spooner's work is singularly defective. In an essay or chapter on breeding, in Part II., we are treated to a disquisition on the merits of the several kinds of sheep which should have been embodied in the description of the several breeds in Part I. In the section devoted to feeding, there are certain theoretical considerations on the size and structure of the chest and abdomen, which should have appeared in the account of the structure of those regions given in an earlier part of the same section.

It is a most ungracious task to write unfavourably of a work of this kind, but the truth is that this new edition affords evidence of great want of care and thought in its preparation. Words and phrases, and even whole sentences, occur throughout the work which illustrate this statement. Take, for example, the following sentence, which occurs in the section on feeding:—"The superiority of particular improved breeds is now generally acknowledged, and may indeed be considered to be established on certain principles, though in arriving at these principles it must be confessed that we are little indebted to science, but rather to the long and attentive observation and correct reasoning of practical men." Overlooking the defective structure of the whole of this sentence, we would observe that the author's view of the nature of science must be peculiar, to say the least of it. If attentive observation and correct reasoning be not science, we should like to know how science ever arose. It would seem as if speculative reasoning were synonymous with science in the mind of our author.

We take another illustration of the culpable want of care bestowed on the preparation of this work from the section devoted to the treatment of scab. Dipping in arsenic is first of all recommended as one of "the most simple and most effectual." Nothing has been said of the dangers attending the use of this substance, or of the consequences which have often followed its use. Mercurial ointment is also recommended. We are told that "tobacco-water is another remedy which has been found effectual, but the high duty it is subject to limits its application." The author ought to have known that tobacco used for this purpose has been for some time exempt from duty on certain conditions. An excellent preparation, the *nicotine* dip, is thus manufactured.

We have had in view in the foregoing remarks the utility of this work to practical men who may seek in its pages facts and principles which would be of direct use and benefit to them in their pursuit of agricultural wealth. Possibly the author intends that it should become a text-book for the use of the 760 persons who, according to the last census, are learning farming professionally in England and Wales. Many of these will, it is to be hoped, in due time, become the agricultural luminaries of their country. It is of national importance that their minds should be thoroughly filled with the great truths of scientific agriculture. They can pick up facts readily enough on the several farms on which they reside; but to books they must look mainly for an exposition of scientific principles. To review this book, or any kindred work, in a way which would be of value to the agricultural student, would require more space than is at our disposal. We shall therefore select one subject well adapted to our purpose, and notice the author's treatment of it. That subject is breeding, which to the agricultural student and to the nation at large possesses the deepest possible interest. The section, or essay, on this subject is introduced under a high-sounding title—"The Principles and Practice of Breeding." We expected a masterly exposition of principles and an array of facts to maintain them. We have been disappointed. Some principles enunciated, which are either wholly or partially true, are illustrated by unhappy examples; and statements are made which are either questionable or contradicted by other statements. In common with many authors and breeders, Mr. Spooner is of opinion that in the offspring the characteristics of the male prevail in the majority of cases (p. 145). The discussion of this subtile topic would occupy much space. We cannot enter upon it now. But if the statement were true in the way Mr. Spooner puts it, the majority of lambs would be of the male gender; but it is not always so. In support of the above proposition we are reminded that "the mule partakes more of the nature of its sire, the ass, than of its dam, the mare." This is quite true; but is it not also true that the jennett is more like its dam, the ass, than its sire, the horse? The statements copied from one work into another on the paramount influence of the male are based partly on erroneous views, and partly on inadequate facts. Given a male and female equal in breeding, in age, and vigour of constitution, they will contribute equally to the characters of the offspring. As a rule the male in every class of live stock is better bred than the female; and as a matter of course the offspring partakes more of his characteristics. Mr. Spooner does not appear to have appreciated the hereditary influence. "Some farmers," he says, "are real advocates for a pure breed and a long pedigree, whilst others despise the pedigree and prefer gaining their ends by means of crossing. Each to a certain extent is right, and each wrong." We ask, how can any person be right to any extent, who despises pedigree? Again, we are told, in the same page, that "a long pedigree may be useless." We give Mr. Spooner credit for more intelligence than to believe he entertains the opinion which those words convey. Indeed, we go so far as to express our belief that, owing to the peculiar style in which he writes, his words do not always convey his real views. We find additional evidence of this in his remarks on breeding in-and-in. Any person conversant with the first principles of breeding knows that breeding in-and-in intensifies the hereditary influence. Two rams, for example, equal in size, age, shape, vigour, and quality, but differing in this—that one is closely bred, while the other is not, will leave their marks on the offspring in very different degrees. The one which is closely bred will, as every breeder of experience and intelligence knows, perpetuate his own points with much greater certainty than the other. According to the language of Mr. Spooner, we should look chiefly to the "resemblance" of the parents. "The stronger resemblance," he says, "there is between the qualities of both parents, if they are good, the more likely is it that the offspring will be perfect." While it is quite true that the nearer the sire and dam approach to each other in shape and quality the better, we are not to recognise this as the embodiment of any fundamental principle of breeding. One of the most difficult things the breeder of improved stock has to effect is to produce uniformity of type or resemblance. The question is, How is it to be done? The answer is this: Skill must be exercised in pairing animals until the desired qualities are produced; and those qualities once obtained, are fixed by close breeding. It is thus that the qualities of shorthorn cattle and Leicester sheep were permanently established. And it is thus, and thus only, that any breeder of our time, or of future time, can succeed in establishing an improved variety of our domestic animals.

In this section of his book, as well as in other parts of it, Mr. Spooner gives a large number of useful and instructive facts on the subject of crossing. We feel very great pleasure in adding that his remarks on this important subject will be worth many times the cost of the work to thousands of sheep-farmers in Great Britain.

CLOWES'S PRACTICAL CHEMISTRY

An Elementary Treatise on Practical Chemistry and Qualitative Inorganic Analysis, specially adapted for use in the Laboratories of Schools and Colleges, and by Beginners. By Frank Clowes, B.Sc. Lond., Science Master at Queenwood College. (London: J. and A. Churchill, 1874.)

IF the rate of progress of a science is to be measured by the number of text-books produced annually, Chemistry must assuredly advance with greater strides than any of its sister sciences. Whether this is actually the case we leave to our readers to judge, contenting ourselves here with pointing out the fact that while English Physics is represented by a few manuals, of which a considerable proportion are translations from foreign works, the market is, so to speak, glutted with an ever-increasing stock of chemical text-books.

The volume now before us is the production of a practised teacher of the science, and will doubtless be found of service outside the author's own classes. The work is divided into seven sections and an appendix. In the first section the student is introduced to experiments illustrating the methods of preparation and properties of the common gases, such as oxygen, hydrogen, carbon dioxide, nitric oxide, ammonia, carbon monoxide, chlorine, and hydrochloric acid. After the preparation of these gases the student is made acquainted with the process of distillation as applied to water, and to the preparation of nitric acid. The entire absence of theory from this section is perhaps to be regretted. Although a student may have previously read the reactions that occur in the preparation of the various gases, there is no more favourable opportunity for impressing these upon the mind than at the time of performing the experiment for himself. If beginners were always to ask themselves, What *chemical* change is going to occur in this tube or flask? and then write down the equation, the knowledge gained would not be of that purely mechanical nature which the boring of corks and bending of glass tubes alone tend to engender.

Section II. treats of the preparation and use of the apparatus required for analysis. Bunsen's burner, the spirit lamp, blowpipe, bending and cutting of glass tubing, cork-boring, and other practical minutiæ, are here described, and some valuable hints given on the use of the various pieces of apparatus employed by the student of analysis.

The details of glass-working seem to us somewhat misplaced here. Tubing must be bent, and corks bored and fitted into flasks, tubes, &c., in the course of fitting up the apparatus for the preparation of gases; so that it would be more logical if this section were made to precede Section I. We miss from this section, also, any reference to the excellent blowpipes made on Herapath's principle, now so generally employed in our laboratories. Students who have once used these blowpipes soon abandon the old mouth blowpipe figured in the present work.

The various operations connected with analysis are described and experimentally illustrated in Section III. Here the student is made acquainted with the processes of solution, crystallisation, filtration, evaporation, precipitation, ignition, &c., and the way is thus prepared for the next section, wherein are given the analytical reactions of the more commonly occurring metals. The author adopts the usual analytical classification; this section, indeed, offers but little scope for originality, and we find the same tests and reactions which are to be found in the works of Fresenius and Rose, and the many volumes of their imitators. The modicum of theory relating to the use of symbols and the expression of reactions as equations, which we should have preferred to see in an earlier portion of the book, finds place at the beginning of the present section. We are glad to see equations given for most of the reactions of the metals; too often the words "white pp." or "black pp." go down into the student's note-book without any idea of what chemical change has occurred having entered into his mind. After the reactions of the metals of each group, tables are given showing the characteristic differences between the members of that group and the methods to be pursued in the cases of mixtures. This plan of tabulating the differences between the various metals of a group is a special feature of the present work; in this country the idea seems to have been first introduced into Galloway's "Manual of Qualitative Analysis," and its adoption by Mr. Clowes is to be highly commended. When a student is made to go through a long series of reactions with closely allied metals, he is apt to overlook the points in which they differ unless these are specially pointed out to him. It is as though a zoologist were to give lengthy descriptions of two closely allied species of a genus without any reference to their differential characters. The reactions of the acids, inorganic and organic, follow those of the metals.

Passing on to Section V., we find the ordinary course of analysis pursued in the case of a simple salt containing one base and one acid, the tables being modified to meet the cases of solids and liquids, acid or alkaline.

In the following section, containing the complete course of analytical tables for complex mixtures, we recognise the well-known tables compiled, we believe, by Dr. Hofmann for the Royal College of Chemistry. The phosphate table devised by Mr. Valentin has been introduced with the author's permission. The present work offers, therefore, as good an analytical course as is to be found in any of our text-books, the type in which the tables are printed is decidedly small, but the plan of printing them *across* instead of *along* the page, offers, as the author justly claims, a distinct advantage.

Section VII. is devoted to a description of apparatus and reagents used in the analytical course. The methods given for constructing pieces of apparatus for general use, and the preparation of special reagents such as hydrofluosilicic acid, will be found valuable adjuncts to the book. The appendix contains a list of elements with their symbols and atomic weights, formulæ for the conversion of thermometric scales, and tables of weights and measures.

It will perhaps be better not to inquire into the *raison d'être* of the work an outline of which we have now laid before our readers. It may be asked why the student should not be made acquainted with the method of preparation and properties of nitrogen, nitrous oxide, phosphoretted hydrogen, and cyanogen; these gases surely are of sufficient chemical importance to justify a knowledge of their properties, and their preparation cannot but furnish good exercise for the manipulatory skill of a student. The list of corrigenda is certainly alarming, and we hope the author will have the opportunity of correcting these in a later edition.

The defects we have had occasion to point out in the course of this notice are not, it must be admitted, of a very grave character. We do not scruple to say that the author has performed his task on the whole well, and we should have no hesitation in putting the book into the hands of the chemical student.

The present volume may, in fact, be taken as a fair average specimen of the systems of teaching practical chemistry followed in this country, and as such we shall venture a few remarks upon it in concluding. In the first place, we should like to see a little more *science* introduced into our courses of analysis—something of the nature of a chemical key to the analytical tables is in our opinion a desideratum. At present the student generally follows blindly the instructions given in the tables; he dissolves, precipitates, or filters without any regard to the chemical reactions occurring at the various stages. It is similar to the old system of learning off a problem of Euclid by heart, without entering into the reasoning—change the order of the letters, and confusion is the result. Then, again, we venture to think that a little more of what we may call manufacturing chemistry might be with advantage introduced into our laboratories. After preparing the gases, the student goes on to study the analytical reactions of the metals, where there is very little scope for manipulation. Between these stages, or simultaneously with the latter, the preparation on a large scale of some of the reagents used in analysis, or of some compounds demanding skill and caution, such, for example, as the chlorides of phosphorus, would give a more extended knowledge of practical details, and at the same time furnish the student with a certain amount of technical instruction equally valuable to him as a scientific man or as a manufacturer.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

The Royal Agricultural Society and the Potato Disease

MY attention has been drawn to a letter in NATURE, vol. xi. p. 67, signed "W. T. Thiselton Dyer," and headed "Royal Agricultural Society and the Potato Disease." It appears that Prof. Dyer has founded the statements and criticisms in that letter upon a paragraph which appeared in the preceding number of NATURE. Had he taken the trouble to read the official reports that have been published by the Society in the agricultural newspapers, the criticisms he might then have made would probably have had some value; and I must express my surprise that a man of scientific pursuits should have omitted to take that most necessary and most elementary course which I may term the verification of fundamental facts. This is the more remarkable as he criticises the Society's want of "methodical scientific method of investigation."

Prof. Dyer asks, "Is it not surprising that the Royal Agricultural Society should think the offer of a 100*l.* prize for an essay in any way an adequate method of dealing with the subject?" Now, what does Prof. Dyer mean by this question? He seems to imply that the Royal Agricultural Society offered such a prize, and that therefore they thought it an adequate method of dealing with the subject. But the Society did not offer such a prize, and have not considered whether such a method would or would not be adequate to deal with the subject.

The truth is, that Lord Cathcart offered such a prize two years ago, and asked the Council of the Society to nominate the judges and otherwise to take charge of the competition. This they did, and for this alone are they responsible.

Prof. Dyer proceeds: "The Society then determined to offer prizes for disease-proof potatoes." To this I must beg leave to reply that the Society did *not* offer prizes for "disease-proof potatoes," but for potatoes which should resist disease for three years in succession in twenty different districts of the United Kingdom. If the somewhat lengthy statement of the terms on which the prize was offered has been colloquially abbreviated into "disease-proof potatoes," that does not justify a scientific man in basing an argument upon it, especially in the columns of a scientific journal.

Prof. Dyer continues: "The utter futility of this proceeding was clearly obvious to anyone in the least acquainted with the subject." Here again I must join issue with the Professor. This prize was offered because certain essayists asserted, and seedsmen advertised, that they possessed varieties of potatoes which would resist disease. To put these statements to the test was in conformity with the Society's ordinary practice, which is to endeavour to make its members acquainted with the actual agricultural value of various articles, whether they be seed-potatoes, manures, implements, or other commodities. As the result has been to show that none of the potatoes experimented upon can resist disease for even one year in our twenty stations, the members of the Society now know what value to attach to the assertions of their proprietors, and the result is therefore not utterly futile.

These experiments have also been utilised to ascertain the influence of soil, climate, and modes of management on the crop itself, and on the potato disease; and the results of this inquiry are now being worked out.

Prof. Dyer goes on to say: "Now, it seems to me that this spasmodic and ill-considered way of dealing with a serious subject contrasts, to an extent that it is impossible quite to regard with satisfaction, with the course that would be adopted in such a matter in other countries. It shows, at any rate, how little the methodical scientific method of investigation is understood by the majority of well-informed English people." I am content to ask Prof. Dyer to point out what is "spasmodic" and what is "ill-considered" in the action of the Society, and how does he justify his assertion about "the methodical scientific method of investigation?"

It must be remembered that the Royal Agricultural Society was not established for the advancement of science, and certainly not for the advancement of botany; but it was established for the promotion of agriculture, especially by the encouragement of the application of the discovered truths of science to the practice of agriculture, as is shown by its motto, "Practice with Science."

The Royal Agricultural Society does, however, enlist the services of scientific men upon its regular staff, and in this and other ways seeks to direct their attention to agricultural problems upon which the light of science is still wanting. As Prof. Dyer has contrasted the Society's "spasmodic and ill-considered way" with "the course that would be adopted in such a matter in other countries," I hope that he will inform me of the course that Agricultural Societies in other countries have adopted in reference to the potato disease and other such matters, without receiving assistance from the Government of the country.

I now come to what Prof. Dyer calls his "second point." He states that the Society, "anxious not to be entirely foiled, offered a sum of money to a well-known investigator of the life-history of fungi, Prof. de Bary, of Strasburg, to induce him to study the potato disease. Considering that De Bary had already written an admirable memoir on the *Peronosporeæ*, there was a certain simplicity in supposing that the gift of a sum of money would elicit some additional information which his zeal as a scientific investigator had failed to do."

So far as I understand the meaning of the phrase "anxious not to be entirely foiled," it implies some previous disappointment. Now, so far is this from having been the fact, that the *first* step taken by the Council of the Society was to direct me to write to Prof. de Bary and urge him to continue his researches into the life-history of *Peronospora infestans*, in view of the vast importance of the subject in its agricultural bearings. Therefore I cannot see how the term "anxious not to be entirely foiled" can be made applicable to it.

The Society at the same time volunteered to place a sum of money at his disposal towards defraying the expenses which he might find it necessary to incur, but I hope that my communication to Prof. de Bary was not conceived in the offensive spirit which Prof. Dyer seems to suggest. The principle involved has been adopted by the British Association as one of the best means of advancing science, and I consider it a very different matter from that "certain simplicity" which Prof. Dyer derides.

This was not only the first, but it was the only step then taken by the Society in reference to the scientific questions bearing upon the potato disease; and its results up to this time are in no respect indicated by the grotesque statements which Prof. Dyer quotes.

H. M. JENKINS,
Secretary of the Royal Agricultural
Society of England

Nov. 29

Anabas Scandens

IN a short notice of the contents of the August number of the *Bulletin de la Société d'Acclimatation de Paris*, in NATURE, vol. xi. p. 98, reference is made to M. Cabonnier's announcement of "the arrival from India of several specimens of three varieties of fish *never hitherto brought to Europe*—the *Anabas scandens* or Climbing Perch," &c. With respect to the *Anabas scandens*, I wish to remark that in April 1872 I sent from Calcutta to the Gardens of the Royal Zoological Society of Ireland two specimens of this fish. Both specimens arrived safely and were exhibited in a tank in the Gardens; one died soon after arrival, the other lived for several months, succumbing at length to the cold of the following winter.*

Royal Victoria Hospital, Netley, Dec. 5 G. E. DOBSON

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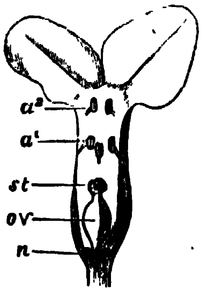
* See Forty-first Annual Report of the Royal Zool. Soc. of Ireland: also P. Z. S. Lond. 1874, p. 319.

FERTILISATION OF FLOWERS BY INSECTS *

VIII.

Alpine Species adapted to Cross-fertilisation by Butterflies, while the most nearly allied species which inhabit the plain or lower mountain region are adapted to Cross-fertilisation by Bees.

IN the last article I attempted to show that in the Alpine region Lepidoptera are far more frequent visitors of flowers than in the plain and lower mountain region, while the frequency of Apidæ, not only absolutely but to a still greater extent relatively, is greatly diminished towards the snow-line. If this be so, whatever may be the cause of the fact, it is hardly to be supposed that the different proportion of visitors of such different structure as butterflies and bees should not have in any way influenced the adaptations of the flowers; and indeed, even during my short stay in the Alps, I succeeded in finding some species of flowers adapted to cross-fertilisation by butterflies, their most nearly allied species which inhabit the plain or lower mountain region being adapted to cross-fertilisation by bees.



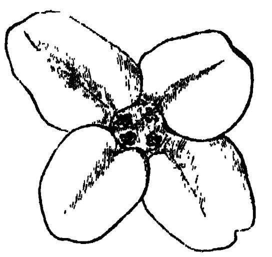
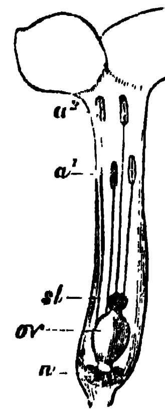


FIG. 41.—*Daphne Mezereum*, L., dissected longitudinally. FIG. 42.—The same flower viewed from above. (Both figures 3½ times natural size.)

1. *Daphne Mezereum* and *striata*.—In both species (Figs. 41-44) the nectar is secreted in an annular swelling (*n*) at the base of the ovary (*ov*), and is contained in the lowest part of the tubular corolla, which includes (1) the ovary (*ov*), terminated by a short-styled, knobbed stigma (*st*); (2) four lower anthers inserted above the centre of the corolla-tube (a^1); and (3) four higher anthers inserted near its mouth (a^2). In both species, therefore, the proboscis of a visiting insect, when in search of the honey, grazes at first the higher, then the lower anthers, and at last the stigma; but the pollen-grains, being only slightly sticky, scarcely adhere to the proboscis, and, at the most, some few grains will be brought by it to the stigma of the same flower. Only when retreating out of the flower will the proboscis, wetted with honey, be dusted by any considerable number of pollen-grains, which will partly be deposited on the stigma of the next visited flower. Thus cross-fertilisation is secured in case suitable insects visit the flowers, whereas when visits of suitable insects are wanting, pollen may easily fall down in both species from the anthers upon the stigma of the same flower, and effect self-fertilisation.



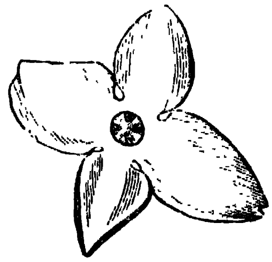


FIG. 43.—*Daphne striata*, Trat., dissected longitudinally. FIG. 44—The same flower viewed from above. (Both figures 3½ times natural size.)

Agreeing thus far, the flowers of the two species differ remarkably in the length and width of the corolla and in the insects which they attract. The corolla-tube of *Daphne Mezereum* being 6 mm. long and 2 mm. wide, its honey is accessible to a great number of bees, among them to all humble-bees, and to some flies (Eristalis, Rhingia), which will be attracted by the bright red colour, and when seeking for honey and flying from flower to flower will regularly effect cross-fertilisation. The honey is also accessible to butterflies, but in consequence of the width of the corolla-tube the slender proboscis of these insects will often be entered and retracted without touching anthers and stigma. *Daphne striata*, on the contrary, with corolla-tubes of 10-11 mm. long, the entrance of which is only 1 mm. wide, is hardly accessible to any insects except Lepidoptera; and the pale rose or whitish colour of its flowers, crowded together in tens or twenties into umbels, and the entire absence (or nearly so) of scent in the day-time, while they emit a remarkably sweet scent during the evening twilight, prove them to be adapted to Sphingidæ and moths,* which, when visiting the flowers, in consequence of the narrowness of the corolla-tube, cannot avoid grazing the anthers and stigma and regularly effecting cross-fertilisation.

FIG. 45.

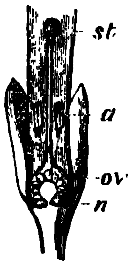


FIG. 46.

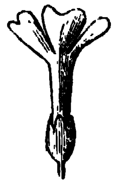


FIG. 47.

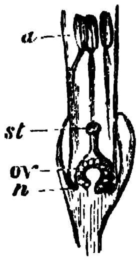


FIG. 48.

FIG. 45.—*Primula villosa*, Facq. Long-styled flower, natural size. FIG. 46. Lower part of the same flower, longitudinally dissected; 3½ times natural size. FIG. 47.—Short-styled flower, natural size. FIG. 48.—Lower part of same flower, longitudinally dissected; 3½ times natural size. *n*, nectary; *ov*, ovary; *st*, stigma; *a*, anthers.

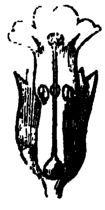


FIG. 49.

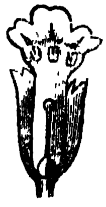


FIG. 50.

FIG. 49.—*Primula officinalis*, Facq. Long-styled. Natural size. FIG. 50.—The same: Short-styled flower, longitudinally dissected. (Copied from Hildebrand, "Geschlechtervertheilung," p. 34.)

2. *Primula officinalis* and *villosa* (Figs. 45-50) are connected with one another by a relation analogous to that between *Daphne Mezereum* and *striata*. Both offer the remarkable contrivances for cross-fertilisation which Mr. Darwin has discussed in so masterly a manner in his paper on Primula,† that is to say, both possess two forms of flowers, a long-styled (Figs. 46, 49) and a short-styled (Figs. 48, 50), growing on different stems and existing in nature in about equal number. As is evident from the

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* Continued from p. 33.

* I have not yet succeeded in actually observing the fertilisation of either of these two species of Daphne.

† "On the Two Forms or Dimorphic Condition in the Species of Primula and their remarkable Sexual Relations." Proc. Linn. Soc. vi. (1862). Bot. pp. 77-99.

FERTILISATION OF FLOWERS BY INSECTS *

VIII.

Alpine Species adapted to Cross-fertilisation by Butterflies, while the most nearly allied species which inhabit the plain or lower mountain region are adapted to Cross-fertilisation by Bees.

IN the last article I attempted to show that in the Alpine region Lepidoptera are far more frequent visitors of flowers than in the plain and lower mountain region, while the frequency of Apidæ, not only absolutely but to a still greater extent relatively, is greatly diminished towards the snow-line. If this be so, whatever may be the cause of the fact, it is hardly to be supposed that the different proportion of visitors of such different structure as butterflies and bees should not have in any way influenced the adaptations of the flowers; and indeed, even during my short stay in the Alps, I succeeded in finding some species of flowers adapted to cross-fertilisation by butterflies, their most nearly allied species which inhabit the plain or lower mountain region being adapted to cross-fertilisation by bees.

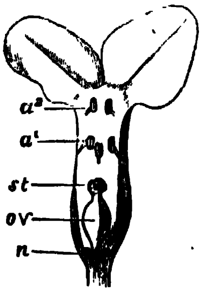

FIG. 41.—*Daphne Mezereum*, L., dissected longitudinally.

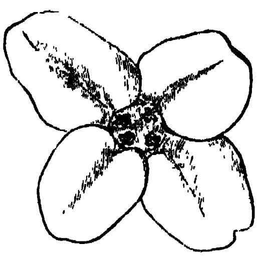

FIG. 42.—The same flower viewed from above.

(Both figures 3½ times natural size.)

1. *Daphne Mezereum* and *striata*.—In both species (Figs. 41-44) the nectar is secreted in an annular swelling (*n*) at the base of the ovary (*ov*), and is contained in the lowest part of the tubular corolla, which includes (1) the ovary (*ov*), terminated by a short-styled, knobbed stigma (*st*); (2) four lower anthers inserted above the centre of the corolla-tube (a^1); and (3) four higher anthers inserted near its mouth (a^2). In both species, therefore, the proboscis of a visiting insect, when in search of the honey, grazes at first the higher, then the lower anthers, and at last the stigma; but the pollen-grains, being only slightly sticky, scarcely adhere to the proboscis, and, at the most, some few grains will be brought by it to the stigma of the same flower. Only when retreating out of the flower will the proboscis, wetted with honey, be dusted by any considerable number of pollen-grains, which will partly be deposited on the stigma of the next visited flower. Thus cross-fertilisation is secured in case suitable insects visit the flowers, whereas when visits of suitable insects are wanting, pollen may easily fall down in both species from the anthers upon the stigma of the same flower, and effect self-fertilisation.

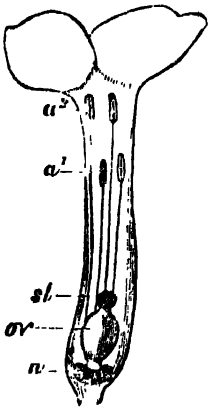

FIG. 43.—*Daphne striata*, Trat., dissected longitudinally.

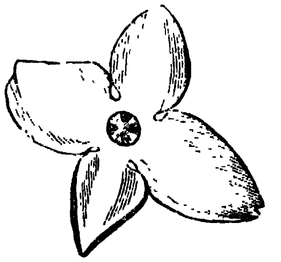

FIG. 44.—The same flower viewed from above.

(Both figures 3½ times natural size.)

Agreeing thus far, the flowers of the two species differ remarkably in the length and width of the corolla and in the insects which they attract. The corolla-tube of *Daphne Mezereum* being 6 mm. long and 2 mm. wide, its honey is accessible to a great number of bees, among them to all humble-bees, and to some flies (Eristalis, Rhingia), which will be attracted by the bright red colour, and when seeking for honey and flying from flower to flower will regularly effect cross-fertilisation. The honey is also accessible to butterflies, but in consequence of the width of the corolla-tube the slender proboscis of these insects will often be entered and retracted without touching anthers and stigma. *Daphne striata*, on the contrary, with corolla-tubes of 10-11 mm. long, the entrance of which is only 1 mm. wide, is hardly accessible to any insects except Lepidoptera; and the pale rose or whitish colour of its flowers, crowded together in tens or twenties into umbels, and the entire absence (or nearly so) of scent in the day-time, while they emit a remarkably sweet scent during the evening twilight, prove them to be adapted to Sphingidæ and moths,* which, when visiting the flowers, in consequence of the narrowness of the corolla-tube, cannot avoid grazing the anthers and stigma and regularly effecting cross-fertilisation.

FIG 45.

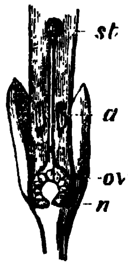

FIG. 46

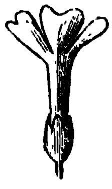

FIG. 47.

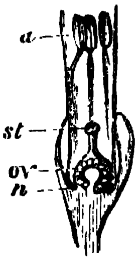

FIG 48.

FIG. 45.—*Primula villosa*, Facq. Long-styled flower, natural size. FIG. 46. Lower part of the same flower, longitudinally dissected; 3½ times natural size. FIG. 47.—Short-styled flower, natural size FIG. 48.—Lower part of same flower, longitudinally dissected; 3½ times natural size *n*, nectary; *ov*, ovary; *st*, stigma; *a*, anthers.

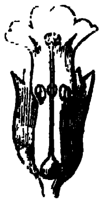

FIG. 49.

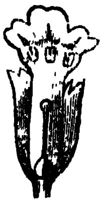

FIG. 50.

FIG. 49.—*Primula officinalis*, Facq. Long-styled. Natural size.

FIG. 50.—The same: Short-styled flower, longitudinally dissected.

(Copied from Hildebrand, "Geschlechtervertheilung," p. 34.)

2. *Primula officinalis* and *villosa* (Figs. 45-50) are connected with one another by a relation analogous to that between *Daphne Mezereum* and *striata*. Both offer the remarkable contrivances for cross-fertilisation which Mr. Darwin has discussed in so masterly a manner in his paper on Primula,† that is to say, both possess two forms of flowers, a long-styled (Figs. 46, 49) and a short-styled (Figs. 48, 50), growing on different stems and existing in nature in about equal number. As is evident from the

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* Continued from p. 33.

* I have not yet succeeded in actually observing the fertilisation of either of these two species of Daphne.

† "On the Two Forms or Dimorphic Condition in the Species of Primula and their remarkable Sexual Relations." Proc. Linn. Soc. vi. (1862). Bot. pp. 77-99.

comparison of Fig. 46 with 48 and of 49 with 50, the anthers of the short-styled form are placed at the same height in the corolla-tube as the stigma of the long-styled, and, conversely, the stigma of the short-styled at the same height as the anthers of the long-styled form. Hence the same part of the body (head or proboscis) of any visiting insect which has touched the anthers of the short-styled form touches the stigma of the long-styled form, and conversely, so that by the regular visits of insects, flowers of the long-styled form are fertilised by pollen of short-styled flowers, and *vice versâ.* Thus in *Primula officinalis* and *villosa,* as in all dimorphic species, intercrossing of different plants takes place naturally; and, as Mr. Darwin has proved by experiment, is the only manner of fertilisation that is followed by perfect fertility. But whilst identical in the arrangement of all the parts of the flower and in their remarkable sexual relations, our two species of Primula differ in the wideness of their corolla-tube to such an extent that the wide mouth of the flower of *P. officinalis* is capable of including the whole head of a humble-bee; whereas the narrow corolla-tube of *P. villosa* is not capable of including anything larger than the proboscis of a humble-bee (compare the corolla-tube in Figs. 46 and 48, which, although three-and-a-half times magnified appears hardly as wide as the mouth of the flower in Figs. 49 and 50, which is the natural size). In consequence of this narrowness, the flowers of *P. villosa* are not only unavoidably cross-fertilised when visited by butterflies, but they are also far more attractive to butterflies, because their honey, inaccessible to humble-bees, is reserved for them alone; indeed, except some little Coleoptera, I observed only Lepidoptera visit the flowers of this Alpine species of Primula,* whereas the flowers of *Primula officinalis* are adapted by their dimensions to the visits of humble-bees, and are actually visited by them.*

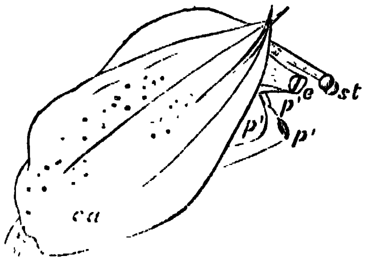

FIG. 51.

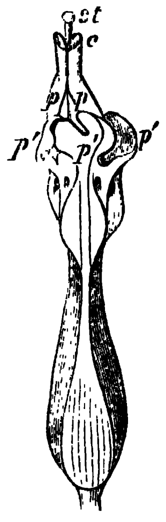

FIG. 52.

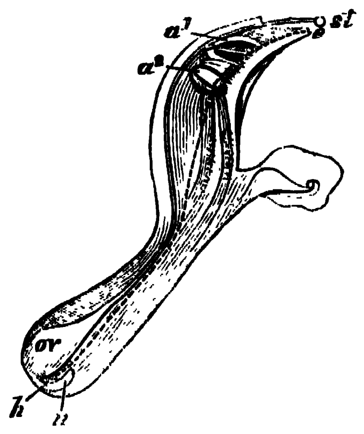

FIG. 53.

A third example of the same relation between Alpine species and those from the lowlands is presented by *Rhinanthus alpinus* (Figs. 51-56), as compared with *R. crista galli* (Fig. 57). *R. crista galli,* which grows in the plain and lower mountain region, presents two varieties or sub-species: *α, major,* and *β, minor,* with different forms of flowers; *major* with more conspicuous ones which never fertilise themseves, *minor* with less conspicuous ones regularly fertilising themselves, in case the visits of insects are wanting (NATURE, vol. viii., pp. 433-435). Both are adapted to cross-fertilisation by humble-bees, which, inserting their proboscis into the comparatively wide entrance of the upper lip (*e*, Fig. 57)

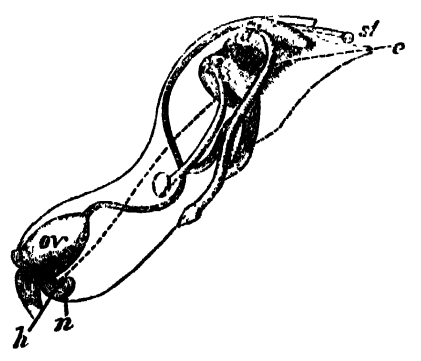

FIG. 54.

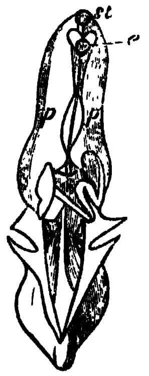

FIG. 55.

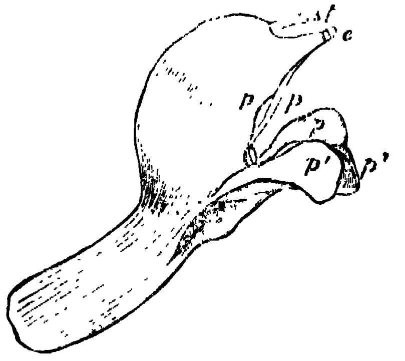

FIG. 56.

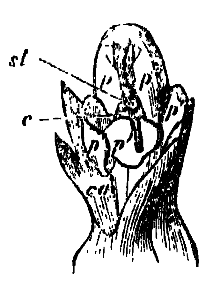

FIG. 57.

FIGS. 51-56.—*Rhinanthus alpinus.*—FIG. 51.—Lateral view of a young flower when still almost entirely enclosed in the calyx (*ca*). FIG. 52.—Corolla of another young flower, somewhat more full-grown, viewed from beneath. FIG. 53.—The same corolla, longitudinally dissected. FIG. 54.—Corolla of an older flower viewed laterally. FIG. 55.—Front view of the same flower. FIG. 56.—Corolla of the same flower, longitudinally dissected, but all four anthers reserved. FIG. 57.—*Rhinanthus crista galli, β* minor.

All figures are 3½ times natural size. In all figures:—*ca*, calyx; *p p*, upper petals, forming together the upper lip; *p' p' p'*, under petals, forming the underlip; *a'*, longer stamens; *a²*, shorter stamens; *n*, nectary; *h*, honey; *ov*, ovary; *st*, stigma. The dotted line on Figs. 53 and 56 signifies the supposed path of the proboscis of butterflies.

* Visitors of *Primula villosa.*—(A.) Coleoptera: *Anthobium excavatum* Er., frequently, crawling without difficulty into the flowers and out of them. (B.) Lepidoptera: *Pieris callidice* Esp., *Zygæna exulans* Rain, both sucking perseveringly and flying from flower to flower.—Piz Umbrail, July 16, 1874.

* Visitors of *Primula officinalis.*—(A.) Coleoptera: *Meligethes.* (B.) Diptera: *Bombylius discolor* Mgn., sucking. (C.) Hymenoptera, Apidæ: *Anthophora pilipes* F., ♀ ♂, *Bombus muscorum* L. ♀, both frequently sucking; *Andrena Gwynana* K. ♀, *Halictus cylindricus* F. ♀ and *Halictus albipes* F ♀, collecting pollen of short-styled flowers.—Thuringia, April 16, 1873.

and pressing it between the upper parts of the filaments, cannot fail to pull asunder the anthers, and thus to cause many loose pollen-grains to fall down upon the proboscis, which are deposited on the stigma of the next flower following.* Thus, in both, cross-fertilisation is secured in case humble-bees visit the flowers, whereas butterflies may easily thrust their slender proboscis down to the honey without even touching the anthers, consequently without any benefit to the plant. Suppose, therefore, that *R. crista galli* (*a*) *major* were growing in the Alpine region, and visited frequently by butterflies, but never or only very exceptionally by humble-bees, all or nearly all the individuals would of necessity perish without leaving posterity, unless any modification of the flowers adapted to cross-fertilisation by butterflies appeared. *R. alpinus* may perhaps be considered as having originated in such a way; for the arrangement and mutual situation of all the parts of its flower is just the same as in *R. major*, with only this modification, that the entrance between the margins of the upper lip (*e*, Fig. 57), through which in both forms of *R. crista galli* butterflies as well as humble-bees thrust their proboscis, in *R. alpinus* is completely closed (*pp*, Figs. 54, 55), only a minute opening (*e*, Figs. 51-56) between two lateral flaps being visible at the tip of the beaked prolongation of the upper lip. No other insects except butterflies would be able to insert their proboscis through this narrow entrance into the flower; and butterflies, when doing so, could not fail to thrust their proboscis between the left and right anthers (as explained by the dotted line in Figs. 53 and 56), and to dust it with pollen-grains, which would partly be deposited on the stigma of the young flower next visited; for in young flowers (as shown in Figs. 51 and 53) the style overtops the tip of the beaked prolongation, and the stigma is placed before the minute opening, just in the way of any entering proboscis, whereas in older flowers the stigma is retracted behind the opening by an incurving of the style (as shown in Fig. 56). HERMANN MÜLLER

THE TRANSIT OF VENUS

THE long-anticipated Transit of Venus took place yesterday morning; and already has the first instalment of news from distant observers arrived. The Astronomer Royal has been good enough to inform us that Col. Tennant's observations at Roorkee, India, have been quite successful; 100 photographs have been taken. He also telegraphs, at the moment of going to press, the gratifying intelligence that the micrometric observations near Cairo and Suez, and the photographic observations at Thebes have entirely succeeded.

At the last meeting of the Astronomical Society the Astronomer Royal gave an account of the final arrangements of the English parties, which do not vary much from those we stated some time ago. Messrs. Green have arranged for one of their outgoing ships to pass near Kerguelen's Land, with a view of picking up intelligence and telegraphing it from Melbourne.

The southern stations occupied by the American, French, and German parties leave no doubt that the Halleyan method will be extensively employed.

The final arrangements of the French parties have been telegraphed to yesterday's *Times* as follows:—

"France has six stations—three in the Northern Hemisphere, at Pekin, Nagasaki, and Saigon; and three in the Southern Hemisphere, at Noumea, Campbell Island, and St. Paul's Island. Three of these, Nagasaki, Cochin China, and Noumea, present comparatively no difficulties as regards the voyage and installation. The Nagasaki Commission is headed by M. Janssen, member of the Institute and the Board of Longitude, who has taken part in several scientific voyages resulting in important discoveries. He is assisted by M. Tisserand, superintendent of the Toulouse Observatory, and M. Picard, a naval lieutenant, who will employ the photographic apparatus of MM. Fizeau and Cornu, while a professional photographer will use an apparatus invented by M. Janssen. In Cochin China there will be only one observer, M. Héraud, a hydrographic engineer. It was at first decided, as a measure of economy, to dispense with the observations in Cochin China, but it was ultimately resolved to profit by M. Héraud's presence in the colony. He will probably be stationed in Tonquin, of which he is preparing a map. M. André, of the Observatory, and M. Angot, of the College of France, have proceeded to Noumea with an equatorial and photographic lens. The observers at Pekin, St. Paul, and Campbell Islands have had to encounter greater difficulties. It is not very easy to reach Pekin with cumbrous luggage. The Commission has had to reach Tien-tsin by Suez and Shanghai, and thence proceed in junks by the canals. It is headed by M. Fifuriais, a naval lieutenant celebrated for his astronomical labours, and comprises two other naval officers, MM. Blarez and Lapied. Their return may be toilsome, as the winter will obstruct the transport of their instruments. At St. Paul and Campbell Islands the observers have had to found a temporary colony in uninhabited islands, without any resources. St. Paul, situated nearly in the centre of the line from the Cape to Australia, is the crater of a volcano which is becoming extinct. There are steep cliffs on all sides, but towards the west the cone sinks, and the interior of the crater forms a creek where vessels can penetrate. No pure water is to be found. The encampment has been established as near as possible to the sea, the salt water having to be distilled for drinking purposes. The St. Paul Commission is composed of M. Mouchez, captain and member of the Board of Longitude, the author of works on the coast of Brazil and Algeria; M. Turquet, naval lieutenant, long accustomed to astronomical observations, as his coadjutor; M. Cazin, an eminent Professor at the Lyceum of the Rue du Havre, who is entrusted with the photography; and a navy surgeon, M. Rochefort, who will devote himself to the natural history of the island. The Commission is accompanied by twelve naval officers and sailors. Campbell Island, the most distant station, is about 200 leagues south of New Zealand. It is likewise uninhabited, its climate seems disagreeable, and, unfortunately, the sky, as at St. Paul, is rarely free from clouds. It possesses, however, good water and a good port. The observers are MM. Bouquet and Hatt, both eminent hydrographic engineers; M. Courrejolles, naval lieutenant; and M. Filbol, the delegate of the Museum and the surgeon of the expedition. There are also twelve sailors. Everything necessary for the subsistence of sixteen men during three months has had to be transported to these two last stations, three months being necessary to determine the exact latitude and longitude of the observatories."

ON THE NORTHERN RANGE OF THE FALLOW DEER IN EUROPE

IN the interesting essay by Dr. Jeitteles, translated by Dr. Sclater, in NATURE, vol. xi. p. 71, many cases of the reputed discovery of the remains of the Fallow Deer are collected together to prove that the animal is indigenous in Northern Europe, and not imported from the south, as heretofore has been supposed by many able naturalists, such as Blasius, Steenstrup, Rütimeyer, the late Prof. Ed. Lartet, and others. These cases are accepted by Dr. Sclater without criticism, and are deemed by him to place the importation theory, as it may be termed, in the category of "ancient fables." The question, however, seems to me, after many years' study of the fossil and recent Cervidæ of this country and of France, a very difficult one, not to be decided off-hand, and certainly not without a strict analysis of the value of evidence such as that recorded by Dr. Jeitteles, whose method and facts appear to be equally in error.

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* H. Müller, "Befruchtung der Blumen durch Insecten," p. 294, *et seq.*

The identification of fragments of antlers is one of the most difficult tasks which a naturalist can take in hand, and where there are several species of deer associated together in the same deposit, it is sometimes impossible to assign a given fragment to its rightful owner. For example, in the forest beds of Norfolk and Suffolk, and in the Pleiocenes of the Continent, there is a vast number of antlers which are ownerless and which have completely baffled Prof. Gàudry, myself, and others for many years. It is, of course, easy for anyone to classify the flat antler as belonging to one species and the round to another; but the value of the determination depends upon the number of species living at the same time in the same place, possessed respectively of round and flattened antlers. In the Pleistocene and Prehistoric ages, there were four animals which had portions of their antlers flattened—the Reindeer, Irish Elk, True Elk, and Stag—to which, according to Dr. Jeitteles, must be added the Fallow Deer. In this particular case it is not only assumed that the flat antler fragments belong to the last of these animals, but even the uncertain testimony of various authors, who had not critically examined the remains, which they record, in relation to the other species, is taken to prove the range of the Fallow Deer as far north as Denmark. The mere printed reference to the Fallow Deer is accepted as evidence, without, save in two cases, being verified by personal examination. The results of such a method of inquiry seem to me to demand most careful criticism.

The alleged cases of the discovery of Fallow Deer in Central and Northern Europe are as follows. In Switzerland, it is stated to have been identified by Dr. Rütimeyer among the animals which had been used for food by the dwellers in the Lake villages; "although," he writes, "incontrovertible evidence of the spontaneous existence of this deer north of the Alps remains still to be obtained" (quoted by Dr. Jeitteles in NATURE, vol. xi. p. 72.) In a list of the Swiss mammalia which Dr. Rutimeyer was kind enough to prepare for me in 1873, the animal is altogether omitted from the Pleistocene and Prehistoric Fauna. Thus, in the opinion of this high authority, it was not living in Switzerland in those early days. The animal is stated also (on the authority of Jäger in 1850) to have been found abundantly in "the caverns and turbaries as well as in the diluvial freshwater chalk of Wurtemburg." To this I would oppose the opinion of my friend Prof. Oscar Fraas, of Stuttgardt, from whose list of animals (sent to me in 1872) the Fallow Deer is conspicuous by its absence. The Reindeer is abundant in the caves of that region, and to it the flattened fragments of antlers may probably be referred.

To pass over the reputed discovery of the animal "in an old place of sacrifice" near Schlieben, in 1828, in which the discoverer himself remarks that "the subject requires further investigation," there only remain three other sets of fragments to be examined in Germany. First, those at Olmütz, which Dr. Rütimeyer considered to belong possibly to the Stag; secondly, an indistinct figure in the "Ossemens Fossiles," of an antler attached to a skull found at Stuttgardt, which seems to me to belong to the Reindeer; and lastly, a fragment of antler from Buchberg, which, taken along with the find at Olmütz, is the second of the two cases identified by Dr. Jeitteles. It is a museum specimen, which may very probably be liable to the same doubts as those which are entertained by Dr. Rütimeyer regarding the fragments from Olmütz. The teeth and bones quoted from Hamburgh are as likely to belong to the Stag as to the Fallow Deer.

The alleged instances of the discovery of the animal in this country and in France are equally unsatisfactory. The flattened antlers alluded to by Buckland and Owen belong either to the Stag or the Reindeer. Among the many thousands of bones and teeth which I have examined from the ossiferous caves of various ages, from refuse-heaps, and tumuli, I have never seen any fragment which could be attributed to Fallow Deer, except in refuse-heaps not older than the Roman occupation. Nor is it found in Ireland till the Middle Ages. The late lamented Prof. Ed. Lartet, whom I always consulted on difficult questions such as these, believed that the animal was not living in Central and Northern France in the Pleistocene or Prehistoric ages, but that it was imported probably by the Romans.

The only evidence against this view is that afforded by an antler dug up in Paris and brought to Prof. Gervais along with stone celts by some workmen. It seemed to me when I saw it in 1873, in the Jardin des Plantes, not altogether conclusive, because of the absence of proof that all the remains were obtained from the same undisturbed stratum. I should expect to find such antlers in the refuse-heaps of Roman Paris, as in Roman London, and I should not be at all surprised if the remains of widely different ages were mingled together by the workmen, even if they were found in the same excavation. As examples of the necessity of guarding against this source of error, I may quote a recent lower jaw of Kangaroo Rat in the collection of my late friend Mr. Wickham Flower, which was stated to have been dug out of the brick-earth near Sittingbourne, along with the mammoth and other Pleistocene creatures; the bones of an ostrich brought to Prof. Busk, along with mammoth and hippopotamus from the gravels of Acton Green; and lastly, the skeleton of Fallow Deer found in a bog not far from the River Boyne above Leinster Bridge (Co. Kildare), along with a skull of Brown Bear (Scott, *Journ. Geol. Soc.* Dublin, vol. x. p. 151). This last case would have been taken as decisive that the animal lived in Ireland in prehistoric times as a contemporary of the Brown Bear, had not a silver collar round its neck proved that it had belonged to "a member of Lord Rosse's family."

From premises so unsatisfactory as those which have been examined, it seems to me very hazardous to conclude with Drs. Jeitteles and Sclater that the Fallow Deer inhabited Northern and Central Europe in the Pleistocene and Prehistoric ages. The point, to say the very least, is non-proven. On the other hand, the non-discovery of certain relics of the animal by the many able naturalists who have examined vast quantities of fossil remains from those regions, implies, to my mind, the probability that the animal was not then in those parts of Europe. The value of negative evidence depends upon the number of observations, which in this case is enormous. To speak personally, I am in the position of a man waiting for satisfactory proof, holding that up to the present time the common Fallow Deer "has never been found to occur in the fossil state in Northern and Central Europe"—a position which I see no reason to change from the arguments brought forward in NATURE. The animal *ought* to be found fossil in those regions; and it is not for want of looking that it has not yet been found.

For the sake of clearness, I have reserved the reference to other forms of deer, in the essay, for separate discussion. The *Cervus polignacus* of Pomel, from Auvergne, is an obscure form without definition, about which I will not venture to say anything. The *Cervus somonensis* of Cuvier, which I have carefully studied in Paris along with Prof. Gervais, is identical with the form which I have described from Clacton, Essex (*Quart. Geol. Journ.*, 1868, p. 514), under the name of *Cervus brownii*. The latter has been identified by Prof. Busk among the fossil remains from Acton Green. The typical antler of Cuvier's species differs from Plate XVII. Fig. 4 of *C. brownii*, in the possession of a palm of four points, and in being broken and badly restored with plaster at the point where the third tyne, *d*, of my figure joins the beam. Whether this kind of antler belongs to a well-marked variety of Fallow Deer or to a closely-allied species, I will not offer an opinion. It seems, however, safer to follow Professors Lartet, Gaudry, and most of the naturalists since the days of Cuvier, in keeping the fossil separate from the living forms, none of which present, so far as I know, a similar variation of antler. Till such an antler be found it is better to keep the animals apart in classification. And even if they be viewed as belonging to one species, they have only been met with in Pleistocene deposits in this country and in France, and they may reasonably be taken as visitors from the south, such as the contemporary hippopotami. In any case I would submit that they do not afford satisfactory grounds for believing with Dr. Sclater that the present distribution of the Fallow Deer in Northern and Central Europe by the hand of man is "an ancient fable." It is undoubtedly an ancient belief, and it is one which can be proved to some extent to be true by an appeal to the records of history.

To enter into the question of the introduction of Fallow Deer into Northern Europe would far outleap the limits of an article. A reference to Lenz's "Zoologie der Alten," and to Neckam's "Natural History," will show to what an extent the wealthy Romans and mediæval barons were in the habit of importing wild and rare animals for the chase, as well as for the sake of mere curiosity.

W. BOYD DAWKINS

THE ENGLISH ARCTIC EXPEDITION

SINCE our note of last week, the preparations for the Arctic Expedition have been advanced an important stage by the selection of Capt. Nares, of H.M.S. *Challenger*, to command the expedition. The choice is a happy one. Capt. Nares distinguished himself on board the *Resolute* in the Arctic Expedition of 1852-54, serving with M'Clintock, Mecham, and Vesey Hamilton. He led the depot sledge for Mecham's more extended journey. On that occasion he went over 665 miles in sixty-five days, while his efficient assistance enabled Mecham to cover 1,006 miles of ground in ninety-four days. Nares was also foremost in providing amusement for the men during the winter quarters, one of the most essential qualifications for Arctic work. His recent experience in the *Challenger* will have made him thoroughly acquainted with the duties required of the commander of a scientific expedition. Commander A. H. Markham, of H.M.S. *Sultan*, will also take a prominent position in the expedition. Capt. Nares was at Hong Kong when he received the telegram offering the command, and probably by this time is on his way home. The command of the *Challenger* will, it is understood, be entrusted to Capt. Frank T. Thomson, now in command of H.M.S. *Modeste*, in China, and who was the first captain selected for official duties in the Royal Naval College at Greenwich.

We announced, a fortnight ago, that the Admiralty had selected Rear-Admiral Richards, C.B., F.R.S., Rear-Admiral Sir Leopold M'Clintock, F.R.S., and Rear-Admiral Sherard Osborn, C.B., F.R.S., to advise them as to the preparations that should be made. This Committee met for the first time on Tuesday week, and have been sitting periodically since.

We understand that the Foreign Office is about to inquire of the United States Government whether the stores sent to a depot on the west coast of Greenland for the use of the *Polaris* are desired to remain there, or whether they may be made available for our expedition. If the United States consent to transfer these stores, it will be of considerable advantage to our ships.

Active preparations are being made at the Royal Victoria Victualling Yard at Deptford, for provisioning the ships which are to be engaged in the expedition. For this purpose 15,000 lb. of beef are undergoing a process of preservation.

It has been proposed, and no doubt very properly, that no persons not actually belonging to the navy can be allowed to take part in the expedition. This, however, effectually precludes any naturalist—as such—being attached to the staff. But the work to be done will principally consist in making collections to be worked up at home. And there is no reason to doubt that, as in the expedition of the *Erebus* and *Terror*, men will be found officially qualified for attachment to the expedition who will use every opportunity of securing for British science the credit of determining the nature of the fauna and flora of the regions in immediate proximity to the pole.

How great an interest is felt amongst naturalists as to the biological results of the expedition, may easily be imagined on reading the following passage from Markham's "Threshold of the Unknown Region" (pp. 201, 202):—

"The winter quarters were in a harbour called 'Thank God' Bay, in lat. 81° 38′ N., and long. 61° 44′ N., which the *Polaris* reached on Sept. 3. . . . The climate of the winter quarters was found to be much milder than it is several degrees further south. In June the plain surrounding 'Thank God' Bay was free from snow; a creeping herbage covered the ground, on which numerous herds of musk oxen found pasture, and rabbits and lemmings abounded. The wild flowers were brilliant, and large flocks of birds came northward in the summer."

The Kew Herbarium possesses four plants presented to it by Commander Markham, who obtained them from Dr. Bessels, of the *Polaris*. They were collected in 82° N. lat., "the most northern position from which any phanerogamic vegetation has hitherto been procured. The locality appears to have been on the east side of Smith's Sound. The species are *Draba alpina*, L.; *Cerastium alpinum*, L.; *Taraxacum Dens-leonis*, Desf. var.; and *Poa flexuosa*, Wahl." (NATURE, vol. viii. p. 487.)

The importance of obtaining information about the marine forms of life, both animal and vegetable, needs no insisting upon.

NOTES

IT will interest our readers to hear that the Berlin Academy of Sciences has set aside a certain sum of money, which will enable it to call to Berlin eminent men of science, who will have no teaching duties to perform. Prof. Kirchhoff has finally decided to accept the directorship of the Observatory for Solar Physics, now being erected at Potsdam, and will proceed to Berlin to commence his duties in connection with its establishment, in the spring.

IT is with great regret that we have to record the death of one of our most promising young naturalists, Mr. J. Traherne Moggridge, whose occasional contributions to these columns gave evidence of the powers of observation and research for which he was distinguished. His works on "Harvesting Ants and Trap-door Spiders," and "Contributions to the Flora of Mentone"—the latter beautifully illustrated by his own hand—contained important additions to our knowledge of different branches of science; a "Supplement" to the former of these works is just now issued from the press. Mr. Moggridge's kindly and unassuming manners had endeared him to a large circle of friends. A love of natural history was with him hereditary, being the grandson of Dillwyn, the monographer of the Confervæ, and joint author with Turner of the "Botanist's Guide." He died on Nov. 24, at the age of thirty-two, at Mentone, where the state of his health had compelled him to spend the winter for several years past. One of his great wishes was to bring his fellow-sufferers to learn, as he had done, that an invalid may be useful and happy.

MR. J. R. HIND writes as follows to the *Times* of Dec. 7, with regard to a new comet:—"Having been favoured with a telegram from M. Stephan, Director of the Observatory of Marseilles, notifying the discovery of a comet by M. Borrelly about four o'clock this morning, we have been able to observe the comet this evening, its present position allowing of observation both evening and morning. The place telegraphed is—Dec. 6, at 16h. mean time at Marseilles; right ascension, 239° 56′; polar distance, 53° 53′; motion towards the north. An uncertainty as to the comparison star unfortunately prevents me from adding the result of my observations this evening, but the comet will be readily found with a good telescope."

IN the same letter Mr. Hind points out that the zodiacal light has been conspicuous for the last few evenings, and that for several years past this phenomenon has been much more marked in December and January than about the vernal equinox.

SURGEON-MAJOR A. LEITH ADAMS, M.D., F.R.S., has been appointed to the Professorship of Zoology in the Royal College of Science at Dublin. Dr. Leith Adams is the author of several works in which natural history forms an important part; among them may be mentioned "Wanderings of a Naturalist in India, the Western Himalayas, and Cashmere," and "Field and Forest Rambles." His elaborate monograph on the "Fossil Elephants of the Maltese Islands" is also on the point of being published in the "Transactions" of the Zoological Society.

DR. J. W. HICKS has been elected to a Fellowship at Sidney Sussex College, Cambridge. Dr. Hicks was Senior in the Natural Science Tripos, and third among the Senior Optimes in 1870. He for some time held the Lectureship in Botany at St. Thomas's Hospital, and is now Demonstrator of Chemistry in the Cambridge University Laboratory. We may mention that though Sidney College was among the first in the University of Cambridge to offer Scholarships in Natural Science, yet its governing body has been chary of further encouraging the study by the bestowal of Fellowships. Ten years ago, indeed, the Senior in the Natural Science Tripos was rewarded by one; but Mr. Hicks has had to wait while wranglers in the "teens" have been preferred to him. We are glad that the College has made amends at last.

THE course for the Natural Science Moderatorships in Trinity College, Dublin, has just been published. It consists of three parts:—1. Physiological and Comparative Anatomy: books recommended, Carpenter's "Human and Comparative Anatomy" and Rolleston's "Forms of Animal Life." 2. Zoology and Botany: books recommended in Zoology, Huxley's "Anatomy of Vertebrates," Foster's "Introduction to Embryology," Nicholson's "Manual of Zoology," and Gegenbaur's "Comparative Anatomy," by Vogt; in Botany, Henfrey's "Course of Botany," by Masters, "Bentham's British Flora," and "Hofmeister on the Higher Cryptogamia," by Currey. 3. Geology and Physical Geography: books recommended, Dana's "Manual of Geology," Haughton's "Manual of Geology," and Keith Johnston's "Physical Geography." If a suggestion may be allowed, it would appear more in conformity with modern ideas that the subjects of the physiology and structure of plants and animals should be treated of as portions of botany and zoology; and surely the distribution of both plants and animals in space and in time appertains more to biology than to geology. Honours are now given in the natural sciences in the Sophister Classes, and the Professors of Geology, Zoology, and Botany give demonstrations in their respective subjects each term.

IN a note on the pollution of the Regent's Canal, the *Lancet* refers to the attempt which has been made to throw the chief blame on the Zoological Society's Gardens, which pour their surface drainage and the contents of their bathing-tanks into the canal. We have, the *Lancet* states, carefully examined the Society's arrangements, and at once acquit them of any blame in the matter. For, though undoubtedly some of the urinary excretion of the animals is carried off by the surface drainage, still the amount is small, and the evil in that respect is more than counterbalanced by the large volume of water (50,000 gallons) daily poured into the canal. Indeed, if that amount of water were in any way diverted, the condition of the canal would, in dry seasons, become worse than it is at present. We were convinced that none of the solid excreta could find their way to the canal through any channel.

WE hope that the meeting held in London on Monday nigh under the presidency of H.R.H. the Duke of Edinburgh will be the means of securing the remaining 30,000*l.* needed to complete the modest sum wanted wherewith to extend the premises of the University of Edinburgh. The meeting was throughout a satisfactory one, and all the addresses, by H.R.H. the Duke of Edinburgh, the Earl of Derby, Prof. Huxley, Dr. Lyon Playfair, Prof. Allman, and others, were pervaded with a strong feeling as to the necessity for an all-important place in education being given to practical training in science. Indeed, it was distinctly stated by Prof. Huxley that the demand for space was not simply owing to the great increase of students in past years, but to the total and happy revolution which had been effected within the last twenty or thirty years in the mode of teaching all branches of physical science. When he was a medical student, the only branch of scientific study properly taught—namely, by practical instruction—was anatomy. It had now, however, come to be understood that what was true of anatomy was true of all branches of science—that no man could know anything about science unless he worked at it practically with his hands. That was the only knowledge on which he could really depend. Hence had arisen the demand for scientific laboratories, in which the student not only had the means and appliances of investigation, but had his work superintended by practical instructors. That demand had increased tenfold the requirements of any teaching body that would do its work worthily, and without the requisite accommodation the scientific teaching of the University could not possibly yield any sound and fruitful results. Moreover, it had come to be recognised that a man could not be a successful teacher, exercising a moral influence on his students which constituted the essential difference between a professor and a book, unless he was himself an original investigator, promoting and increasing knowledge. We have no doubt that we shall soon be able to announce that the whole 100,000*l.* has been subscribed.

A PAPER on "University Development in Scotland," reprinted from the *Perthshire Constitutional*, has been sent us. It takes Edinburgh University, the largest (it has 1,800 students this year) and best known of the Scottish Universities, as representative of the others, and points out several directions in which there is room for improvement. The writer takes the German University as in some sort a model, and points out the following defects in the Scottish Universities:—(1) The want of sufficiently extensive and suitable buildings; (2) There should be a material increase in the teaching staff; (3) There should be a better endowment of professorships; (4) Graduates should be encouraged to devote themselves to *original research* by the provision of liberally endowed professorships; (5) There should be more liberal superannuation of professors after a shorter period of service. The writer urges on all those who have been educated in Edinburgh, and on all who wish to see it keep its position, to lend a hand in the movement now on foot to raise a sum sufficient to provide the University with the additional buildings which are absolutely necessary to its efficiency.

At the meeting of the Dundee Town Council last Thursday, a letter from the directors of the Albert Institute of that town was read by Provost Cox, in which it was stated that a scheme for the erection of a college had been prepared, and the co-operation of the Council in the furtherance of the work was requested. It was proposed to establish a college in Dundee in connection with the St. Andrews University, and that at first the college should be opened with six chairs—namely, English Literature and Logic, Chemistry, Natural Philosophy, Engineering, Natural History or Greek and Latin, and Mathematics. To defray the expense of the erection of the college and to pay the salaries, 150,000*l.* would be required at the outside. If the college should succeed, it was proposed to add the following additional chairs—viz., Mental and Moral Philosophy, Political Economy, Ancient or Modern History, Latin and Greek or Natural History, Geography and Astronomy, and Physical Geography and Navigation. To endow these additional chairs a further sum of 75,000*l.* would be required. It was proposed that the management of the college should be carried on by the courts which at present manage the colleges at St. Andrews, the only addition to the University Courts of St. Andrews being that the following gentlemen should be members of that Court:—The Lord-Lieutenant of Forfarshire, the Convener of the County, the Sheriff and Sheriff-Substitute of Forfarshire, and the Provost of Dundee. The Council expressed themselves gratified at the movement, and while stating that they would be willing to give it their hearty co-operation, they resolved to call a special meeting for the consideration of the whole subject, to be held on Tuesday last. We would remind the organisers of the proposed new college of the great value of sound science-teaching to so important a manufacturing and commercial town as Dundee. There is nothing to hinder the wealthy merchants and manufacturers of Dundee starting a college at least equal to the Newcastle College of Science, and they should not rest until they possess an institution as efficient as Owens College, Manchester. This latter institution ought to be taken as a model, where all the so-called "faculties" are complete; a "College of Science," pure and simple, seems to us a blunder.

The formal inauguration of the recently completed portions of the Edinburgh Museum of Science and Art is, we believe, to take place on Jan. 14 next, by a grand *conversazione* to be given by the Lord Provost in the Museum building.

A further instalment (the sixth part) of the new Government Map of Switzerland has recently appeared, containing the sheets Meiringen, Laax, Trons, Ilanz, Greina, Vrin, Andeer, Zweisimmen, Blumlisalp, Peccia, Blasca, and Maggia. Altogether 72 sheets are now published out of the 546 which will be necessary for the completion of the map. Those which have been issued are mainly of the central and north-west portions of the country, and regarding them we can only repeat the opinion that we have already expressed respecting the earlier sheets, namely, that they are equal and in some features superior to any maps of the kind that have yet appeared. Great as the cost of this map will be to the nation, we have no doubt that its expense will be repaid many times, in the facilities which it will afford in the construction of roads and railroads, and for many other purposes.

We take the following from the *Academy*:—Now that the question of the endowment of research is being made so much a subject of discussion, it may interest our readers to learn the following particulars, which we take from the Swedish *Aftonbladet*. About a month since that newspaper drew attention to an appeal for funds made by the botanist Dr. Berggren, who is at present exploring the cryptogamic botany of the mountains of New Zealand. It appears that Dr. Berggren has already made some very valuable explorations, first in Spitzbergen in 1868, then in Greenland in 1870, and now has been sent out to New Zealand with a stipend drawn from a sum of money left by a Herr Lettersted for scientific purposes. Dr. Berggren writes that he has had signal success, especially in discovering species closely analogous to the Arctic forms with which he is familiar, but that his means are at an end. An effort made to induce the Government of Canterbury Province to vote him a sum of money was on the point of succeeding, when an economical frenzy took the Lower Legislative House, and the bill was thrown out. *Aftonbladet* laid these facts before its readers. Almost immediately, the proprietors of another newspaper, *Göteborg's Post*, generously forwarded a large sum towards the prosecution of the work, and private funds came in so rapidly that Dr. Berggren will be able to recommence his valuable explorations directly the next mail reaches New Zealand. This zealous response to the demands of science in so poor a country as Sweden does honour to the intelligence of its people.

A telegram dated Alexandria, Dec. 8, states that two reconnoitring expeditions, each consisting of eight European and twelve native officers and sixty-three soldiers, have been organised by the Egyptian Government, and have started for the Soudan, with the object of surveying the country between the Nile and the provinces of Darfour and Kordofan. Thence the expeditions will proceed to the Equator, west of the Albert Nyanza. They will repair the wells wherever necessary, and prepare maps, and will also report upon the population, climate, and commerce of the country through which they pass.

A meeting of the local committee in connection with the recent meeting of the British Association, was held in Belfast on Saturday. The expense incurred has been about 1,800*l.*, leaving a surplus of more than 500*l.*, which the Executive Committee recommend should be divided among various local institutions.

We would draw attention to a very valuable paper "On the Expediency of Protection for Patents," by Mr. F. J. Bramwell, C.E., F.R.S., published in the *Society of Arts Journal* for Dec. 4.

The additions to the Zoological Society's Gardens during the past week include two Glaucous Gulls (*Larus glaucus*) from Spitzbergen, presented by Mr. R. E. Beaumont; a Common Raccoon (*Procyon lotor*) from N. America, presented by Mr. T. Trimnell; a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mrs. Phillips; a Solitary Tinamon (*Tinamus solitarius*) from Brazil, received in exchange; three Black-footed Penguins (*Spheniscus demersus*) from S. Africa, purchased; a Capybara (*Hydrochœrus capybara*) born in the Gardens.

THE "CHALLENGER" EXPEDITION[*]

II.

THE following Table, taken from the chart, gives a good general idea of the distribution of the two formations with respect to depth. It cannot of course be taken as exact; the indications were jotted down from the impression of colour given at the time, and there is no hard and fast line between Globigerina ooze and grey ooze on the one hand, and between red clay and grey ooze on the other. This Table gives an average depth of 1,800 fathoms for our soundings in the Globigerina ooze. This is datum of no value, for we only rarely sounded in shallow water, and we know that this formation covers large areas at depths between 300 and 400 fathoms; but the mean maximum depth at which it occurs is important, and that may be taken from the Table as about 2,250 fathoms. The mean depth at which we find the transition grey ooze is 2,400 fathoms, and the mean depth of the red clay soundings is about 2,700 fathoms. The general concurrence of so many observations would go far to prove, what seems now to stand indeed in the position of an ascertained fact, that wherever the depth increases from about 2,200 to 2,600 fathoms, the modern chalk formation of the Atlantic and of other oceans pass into a clay.

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[*] Continued from p 97.

No. of Station.	Nature of the Bottom.		
	Glob. Ooze.	Grey Ooze.	Red Clay.
From Cape Finisterre to Teneriffe.			
I.	1125	...	...
	1975	...	...
II.	470	...	...
	1800	...	...
III.	1000	...	...
VI.	1525	...	...
From Teneriffe to St. Thomas.			
1	1890	...	...
2	1945	...	...
4	2220	...	...
5	...	...	2740
6	...	...	2950
7	...	...	2750
8	...	...	2800
9	...	...	3150
10	...	...	2720
11	...	...	2575
12	2025	...	...
13	1900	...	...
14	1950	...	...
15	...	...	2325
16	...	...	2435
17	...	...	2385
18	...	...	2675
19	...	...	3000
20	...	...	2975
21	...	...	3025
22	1420	...	...
23	450	...	...
From St. Thomas to Bermudas.			
25	...	3875	...
26	...	2800	...
27	...	2960	...
28	..	...	2850
29	...	...	2700
30	...	.	2600
31	. .	2475	.
32	.	2250	...
...	..	1820	...
From Bermudas to Halifax.			
37	...	2650	...
38	...	2600	...
39	...	2850	...
42	...	2425	...
44	...	1700	...
From Halifax to Bermudas.			
50	...	1250	...
51	...	2200	...
52	...	2800	...
53	...	2650	...
54	...	2650	...
55	...	2500	...
From Bermudas to the Azores.			
58	...	1500	...
59	...	2360	...
60	...	2575	...
61	...	2850	...
62	...	2875	...
63	...	2750	. .
65	...	2700	...
66	...	2750	...
67	...	2700	...
68	...	2175	..
69	...	2200	...
70	1675	...	...
From Bermudas to the Azores (continued).			
71	1675	...	...
72	1240	...	...
73	1000	...	...
74	1350	...	...
76	900	...	...
From the Azores to Madeira.			
78	1000	...	...
79	2025	..	...
80	2660	. .	...
81	2675	...	...
82	2400	...	...
83	1650	...	...
From Madeira to Cape Verde Islands.			
86	2300	...	...
88	2300	...	...
89	2400	...	...
90	2400	...	. .
91	2075	...	...
92	1975	...	...
From the Cape Verde Islands to St. Paul Rocks.			
95	2300	...	...
97	2575	...	...
98	1750	...	...
102	...	2450	. .
104	...	2500	..
105	. .	2275	...
106	1850	...	...
107	1500	...	...
108	1900	...	...
From the St. Paul Rocks to S. Salvador.			
110	2275	..	...
111	2475	...	.
112	2200	..	...
115	2150	...	. .
116	2275	...	...
From S. Salvador to Tristan d'Acunha.			
129	...	...	2150
130	...	...	2350
131	2275	...	...
132	2050	...	...
133	1900	...	...
134	2025	...	...
From Tristan d'Acunha to the Cape of Good Hope.			
137	...	...	2550
138	...	...	2650
139	...	2325	...
140	...	1250	...
From the Cape of Good Hope to Kerguelen Island.			
143	1900	...	...
144	1570	...	...
146	1375	...	...
147	1600	...	...
From Kerguelen Island to Melbourne.			
158	1800	...	...
159	2150	...	...
160	...	...	2600

The nature and origin of this vast deposit of clay is a question of the very greatest interest; and although I think there can be no doubt that it is in the main solved, yet some matters of detail are still involved in difficulty. My first impression was that it might be the most minutely divided material, the ultimate sediment produced by the disintegration of the land, by rivers and by the action of the sea on exposed coasts, and held in suspension and distributed by ocean currents, and only making itself manifest in places unoccupied by the Globigerina ooze. Several circumstances seemed, however, to negative this mode of origin. The formation seemed too uniform; whenever we met with it it had the same character, and it only varied in composition in containing less or more carbonate of lime.

Again, we were gradually becoming more and more convinced that all the important elements of the Globigerina ooze lived on the surface; and it seemed evident that so long as the conditions on the surface remained the same, no alteration of contour at the bottom could possibly prevent its accumulation; and the surface conditions in the Mid-Atlantic were very uniform, a moderate current of a very equal temperature passing continuously over elevations and depressions, and everywhere yielding to the tow-net the ooze-forming foraminifera in the same proportion. The Mid-Atlantic swarms with pelagic mollusca, and in moderate depth the shells of these are constantly mixed with the Globigerina ooze, sometimes in number sufficient to make up a considerable portion of its bulk. It is clear that these shells must fall in equal numbers upon the red clay, but scarcely a trace of one of them is ever brought up by the dredge on the red clay area. It might be possible to explain the absence of shell-secreting animals living on the bottom, on the supposition that the nature of the deposit was injurious to them; but then the idea of a current sufficiently strong to sweep them away is negatived by the extreme fineness of the sediment which is being laid down; the absence of surface shells appears to be intelligible only on the supposition that they are in some way removed.

We conclude, therefore, that the "red clay" is not an additional substance introduced from without, and occupying certain depressed regions on account of some law regulating its deposition, but that it is produced by the removal, by some means or other, over these areas of the carbonate of lime, which forms probably about 98 per cent. of the material of the Globigerina ooze. We can trace, indeed, every successive stage in the removal of the carbonate of lime in descending the slope of the ridge or plateau when the Globigerina ooze is forming to the region of the clay. We find, first, that the shells of pteropods and other surface mollusca, which are constantly falling on the bottom, are absent, or if a few remain they are brittle and yellow, and evidently decaying rapidly. These shells of mollusca decompose more easily and disappear sooner than the smaller and apparently more delicate shells of rhizopods. The smaller foraminifera now give way and are found in lessening proportion to the larger; the coccoliths first lose their thin outer border and then disappear, and the clubs of the rhabdoliths get worn out of shape and are last seen under a high power as infinitely minute cylinders scattered over the field. The larger foraminifera are attached, and instead of being vividly white and delicately sculptured, they become brown and worn, and finally they break up, each according to its fashion; the chamber-walls of Globigerina fall into wedge-shaped pieces, which quickly disappear, and a thick rough crust breaks away from the surface of Orbulina, leaving a thin inner sphere, at first beautifully transparent, but soon becoming opaque and crumbling away.

In the meantime the proportion of the amorphous "red clay" to the calcareous elements of all kinds increases until the latter disappear, with the exception of a few scattered shells of the larger foraminifera, which are still found even in the most characteristic samples of the "red clay."

There seems to be no room left for doubt that the red clay is essentially the insoluble residue, the *ash*, as it were, of the calcareous organisms which form the Globigerina ooze after the calcareous matter has been by some means removed. An ordinary mixture of calcareous foraminifera with the shells of pteropods, forming a fair sample of Globigerina ooze from near St. Thomas, was carefully washed and subjected by Mr. Buchanan to the action of weak acid; and he found that there remained after the carbonate of lime had been removed, about one per cent. of a reddish mud consisting of silica, alumina, and the red oxide of iron. This experiment has been frequently repeated with different samples of Globigerina ooze, and always with the result that a small proportion of a red sediment remains which possesses all the characters of the red clay.

In the Globigerina ooze siliceous bodies, including the spicules of sponges, the spicules and tests of radiolarians, and the frustules of diatoms occur in appreciable proportion; and these also diminish in number, and the more delicate of them disappear in the transition from the calcareous ooze to the red clay.

I have already alluded to the large quantity of nodules of the peroxide of manganese which were brought up by the trawl from the red-clay area on the 13th of March. Such nodules seem to occur universally in this formation. No manganese can be detected in the Globigerina ooze; but no sooner has the removal of the carbonate of lime commenced than small black grains make their appearance, usually rounded and mammillated on the surface, miniatures, in fact, of the larger nodules which abound in the clay; and at the same time any large organic body, such as a shark's tooth, that may happen to be in the ooze is more or less completely replaced by manganese; and any inorganic body, such as a pebble or a piece of pumice, is coated with it as a fine black mammillated layer. It is not easy to tell what the proportion of manganese in the red clay may be, but it is very considerable. At station 160, on the 13th of March, the trawl brought up nearly a bushel of nodules from the size of a walnut to that of an orange, but these were probably the result of the sifting of a large quantity of the clay. The manganese is doubtless set free like the iron by the decomposition of the organic bodies and tests. It is known to exist in the ash of some algæ to the amount of four per cent.

The interesting question now arises as to the cause and method of the removal of the carbonate of lime from the cretaceous deposit, and on this matter we are not yet in a position to form any definite conclusion.

One possible explanation is sufficiently obvious. All sea-water contains a certain proportion of free carbonic acid, and Mr. Buchanan believes that he finds it rather in excess in bottom-water from great depths. At all events the quantity present is sufficient to convert into a soluble compound, and thus remove a considerable amount of carbonic lime. If the balance of supply be very delicately adjusted, it is just conceivable that the lime in the shells in its fine state of subdivision having been attacked by the sea-water from the moment of the death of the animal, may be entirely dissolved during its retarded passage through the half mile or so of water of increasing density. The bottom-water in these deep troughs has been lost at the surface, a great deal of it in the form of circumpolar freshwater ice; and though fully charged with carbonic acid, it is possible that it may be comparatively free from carbonate of lime, and that its solvent power may thus be greater.

The red clay, or more probably the circumstances which lead to its deposition, seem on the whole unfavourable to the development of animal life. Where its special characters are most marked, no animals which require much carbonate of lime for the development of their tissues or their habitations appear to exist. Our growing experience is, that although animal life is possible at all depths after a certain depth, say 1,500 fathoms, its abundance diminishes. This would seem to indicate that the extreme conditions of vast depths are not favourable to its development: and one might well imagine that the number of shell-building animals might decrease until the supply of lime was so far reduced as to make it difficult for them to hold their own against the solvent power of the water of the sea—just as in many districts where there is little lime, the shells of land and freshwater molluscs are light and thin, and the animals themselves are stunted and scarce.

It seems, however, that neither the extreme depth at which the red clay is found, nor the conditions under which it is separated and laid down, are sufficient entirely to negative the existence of living animals, even of the higher invertebrate orders. In several of the hauls we brought up holothurids of considerable size, with the calcareous neck-rings very rudimentary, and either no calcareous bodies in the test or a mere trace of such. Nearly every haul gave us delicate branching Bryozoa with the zooëcium almost membranous. One fortunate cast, about 150 miles from Sombrero, brought up from a depth of 2,975 fathoms very well-marked red mud, which did not effervesce with hydrochloric acid. Entangled in the dredge, and imbedded in the mud, were many of the tubes of a tube-building annelid, several of them 3 in. to 4 in. long, and containing the worm, a species of Myriochele, still living. The worm-tubes, like all the tests of foraminifera from the same dredging, were made up of particles of the red clay alone.

It seems evident, from the observations here recorded, tha *clay*, which we have hitherto looked upon as essentially the product of the disintegration of older rocks, may be under certain circumstances an organic formation like chalk; that as a matter of fact, an area on the surface of the globe, which we have shown to be of vast extent, although we are still far from having ascertained its limits, is being covered by such a deposit at the present day.

It is impossible to avoid associating such a formation with the fine, smooth, homogeneous clays and schists, poor in fossils, but showing worm-tubes and tracks, and bunches of doubtful branching things, such as Oldhamia, siliceous sponges, and thin-shelled peculiar shrimps. Such formations more or less metamorphosed are very familiar, especially to the student of palæozoic geology, and they often attain a vast thickness. One is inclined, from this great resemblance between them in composition and in the general character of the included fauna, to suspect that these may be organic formations, like the modern red clay of the Atlantic and Southern Sea, accumulations of the insoluble ashes of shelled creatures.

The dredging in the red clay on the 13th of March was unusually rich. The bag contained examples, those with calcareous shells rather stunted, of most of the characteristic deep-water groups of the Southern Sea, including Umbellularia, Euplectella, Pterocrinus, Brisinga, Ophioglypha, Pourtalesia, and one or two Mollusca. This is, however, very rarely the case. Generally the red clay is barren, or contains only a very small number of forms.

On the 11th of February, lat. 60° 52′ S., long. 80° 20′ E., and March 3, lat. 53° 55′ S., long. 108° 35′ E., the sounding instrument came up filled with a very fine cream-coloured paste, which scarcely effervesced with acid, and dried into a very light impalpable white powder. This, when examined under the microscope, was found to consist almost entirely of the frustules of diatoms, some of them wonderfully perfect in all the details of their ornament, and many of them broken up. The species of diatoms entering into this deposit have not yet been worked up, but they appear to be referable chiefly to the genera Fragilaria, Coscinodiscus, Chætoceros, Asteromphalus, and Dictyocha, with fragments of the separated rods of a singular siliceous organism, with which we were unacquainted, and which made up a large proportion of the finer matter of this deposit. Mixed with the diatoms there were a few small Globigerinæ, some of the tests and spicules of radiolarians, and some sand particles; but these foreign bodies were in too small proportion to affect the formation as consisting practically of diatoms alone. On the 4th of February, in lat. 52° 29′ S., long. 71° 36′ E., a little to the north of the Heard Islands, the tow-net, dragging a few fathoms below the surface, came up nearly filled with a pale yellow gelatinous mass. This was found to consist entirely of diatoms of the same species of that found at the bottom. By far the most abundant was the little bundle of siliceous rods, fastened together loosely at one end, separating from one another at the other end, and the whole bundle loosely twisted into a spindle. The rods are hollow, and contain the characteristic endochrome of the Diatomaceæ. Like the Globigerina ooze, then, which it succeeds to the southward in a band apparently of no great width, the materials of this siliceous deposit are derived entirely from the surface and intermediate depths. It is somewhat singular that diatoms did not appear to be in such large numbers on the surface over the diatom ooze as they were a little further north. This may perhaps be accounted for by our not having struck their belt of depth with the tow-net; or it is possible that when we found it on the 11th of February the bottom deposit was really shifted a little to the south by the warm current, the excessively fine flocculent débris of the diatoms taking a certain time to sink. The belt of diatom ooze is certainly a little further to the southward in long. 80° E. in the path of the reflux of the Agulhas current than in long. 108° E.

All along the edge of the ice-pack—everywhere, in fact, to the south of the two stations, on the 11th of February on our southward voyage, and on the 3rd of March on our return, we brought up fine sand and greyish mud, with small pebbles of quartz and felspar, and small fragments of mica-slate, chlorite-slate, clay-slate, gneiss, and granite. This deposit, I have no doubt, was derived from the surface like the others, but in this case by the melting of icebergs and the precipitation of foreign matter contained in the ice.

We never saw any trace of gravel or sand, or any material necessarily derived from land, on an iceberg. Several showed vertical or irregular fissures filled with discoloured ice or snow; but when looked at closely the discoloration proved usually to be very slight, and the effect at a distance was usually due to the foreign material filling the fissure reflecting light less perfectly than the general surface of the berg. I conceive that the upper surface of one of these great tabular southern icebergs, including by far the greater part of its bulk, and culminating in the portion exposed above the surface of the sea, was formed by the piling up of successive layers of snow during the period, amounting perhaps to several centuries, during which the ice-cap was slowly forcing itself over the low land and out to sea over a long extent of gentle slope, until it reached a depth considerably above 200 fathoms, when the lower specific weight of the ice caused an upward strain which at length overcame the cohesion of the mass, and portions were rent off and floated away. If this be the true history of the formation of these icebergs, the absence of all land débris in the portion exposed above the surface of the sea is readily understood. If any such exist, it must be confined to the lower part of the berg, to that part which has at one time or other moved on the floor of the ice-cap.

The icebergs, when they are first dispersed, float in from 200 to 250 fathoms. When, therefore, they have been drifted to latitudes of 65° or 64° S., the bottom of the berg just reaches the layer at which the temperature of the water is distinctly rising, and it is rapidly melted, and the mud and pebbles with which it is more or less charged are precipitated. That this precipitation takes place all over the area where the icebergs are breaking up constantly, and to a considerable extent, is evident from the fact of the soundings being entirely composed of such deposits; for the diatoms, Globigerinæ, and radiolarians are present on the surface in large numbers; and unless the deposit from the ice were abundant it would soon be covered and masked by a layer of the exuviæ of surface organisms.

SCIENTIFIC SERIALS

Poggendorff's Annalen der Physik und Chemie, No. 6.—The first paper, by G. Lundquist, On the reflection of light from the outside of isotropic bodies, is reprinted from the "Transactions" of the Royal Society of Upsala.—Dr. H. Brougersma contributes a memoir On the Medium in electrical influence, in which, following up the experiments of Riess, he examines Faraday's theory of electrical induction by polarisation of the medium, and describes in detail the apparatus with which he experimented, tabulates his results, and agrees with Riess's induction as to a direct influx of electricity.—The next article comprises a series of communications from the Mineralogical Institute of the University of Strasburg, in which Paul Groth treats of the crystalline form and thermo-electric properties of smaltine or arsenical cobalt. Its chemical formula is very variable, $R = (Co, Ni, Fe) As_2$. Eight samples from different localities, which contribute a better knowledge of the hemihedral forms of the species, are discussed. He concludes that some of the forms hitherto regarded as holohedral are hemihedral forms with parallel sides. As with iron pyrites and cobalt-glance, with which it is isomorphous, one part of the crystal is negative towards copper, while the other half is positive.—Dr. Hintze treats of the chemical composition of leadhillite. Prof. Laspeyres two years ago described a mineral from Iglesias, in Sardinia, under the name of maxite, of which the formula was $5PbSO_4 + 9PbCO_3 + 4PbO + 5H_2O$. M. Bertrand, of Paris, soon after published an account of leadhillite from the same neighbourhood. The author proves that the two minerals are identical, and that the formula of leadhillite is not $PbSO_4 + 3PbCO_3$ as hitherto believed, but $2PbSO_4 + 4PbCO_3 + PbO + 2H_2O$. The next paper, by the same author, is crystallographic researches on the combination of aldehyde with the aromatic hydrocarbons. The chemical composition and crystalline forms are given of ditolyltrichloraethan, diphenyltribromaethan, diphenyltrichloraethylen, diphenyldibromaethan, dimonobromphenyltrichloraethan, &c. All these bodies belong to the monoclinic system.—Dr. A. Arzruni gives a short note on twin-growth in willemite. The next paper by the same author is "Optical researches on the turpentinoelhydrates," which he follows by crystallographic and optical researches on compounds of urea. His last paper is on two isomorphous substances derived from benzol.—F. Zollner prints his important paper on the aggregation and position of the sun-spots, and concludes that they are cooled sconaceous products.—Dr. Karl Braun contributes studies on the earth's magnetism.—Among the reprinted papers are Dr. Andrews' on ozone and Prof. Wright's on the polarisation of the zodiacal light.

Memorie della Societa Spettroscopisti Italiani, September 1874.—This number contains a paper by Mr. J. N. Lockyer, describing certain phenomena seen when examining the spectrum of the electric light through a mass of sodium vapour in a tube. When this is done, the sodium lines are seen to shade gradually off, sometimes on one side, sometimes on both, the boundary of the shading being curved and sometimes limited by a bright line.—There is also another paper by the same author, On experiments on the absorption of a great thickness of sodium and iodine vapour in a tube 5 ft. long. After mentioning that it had been hitherto assumed that a great thickness of gas causes its radiation, and therefore its absorption, to become more continuous, he states that, on generalising his work, it appears that when the density of a vapour is increased, a continuous spectrum is approached in the case of the metallic elements of low specific gravity by the widening of their lines, and in that of the elements of high sp. gr. by the increase of the number of lines. To test this, the absorption of sodium vapour in a 5 ft. tube was observed, and the D line was found to be no thicker than the same line produced by a test-tube full of the vapour, and the line was thicker than the D-line in the solar spectrum, in which spectrum all the short lines are reversed.—Father Secchi communicates a letter of A. T. Arcimis, detailing observations on the spectra of meteorites. The spectra of all seem to be continuous, but wanting in the violet, that colour of the spectrum predominating according to its colour to the naked eye. The sodium line was visible in the trail of some, as also were the lines of magnesium.—G. De Sisa gives a table of the solar spots observed at Palermo from June to September.—A table of the chromosphere, as seen during February and March last at Palermo, is added to this number.—E. Fergola contributes a lengthy paper on the position of the axis of rotation of the earth with respect to its axis of figure.

SOCIETIES AND ACADEMIES

London

Linnean Society, Dec. 3.—Dr. G. J. Allman, F.R.S., president, in the chair.—Mr. Jas. Brogden, Sir Edmund Buckley, Bart., M.P., Messrs. Jas. Cowherd, P. Duffy, C. C. Dupré, A. M. Ross, and J. W. Silver were severally elected Fellows of the Society.—Prof. Huxley read a paper On the classification of the animal kingdom, which will be found in another column. An interesting discussion followed, in which the President, Mr. Busk, Mr. H. G. Seeley, Mr. Stewart, Dr. Murie, and others took part.

Chemical Society, Dec. 3.—Mr. W. H. Perkins, F.R.S., in the chair.—A paper was read by Mr. S. Lupton On the formulæ of the alums; the next was a notice On the colour of cupric chloride, by Mr. W. N. Hartley, who finds that the crystals of the salt when quite dry have a blue colour, and not a green, as they usually appear when slightly moist.—Papers were also read On the oxidation of the essential oils, Part II. by Mr. C. T. Kingzett; On the purification and boiling-point of methyl hexyl carbinol, by Mr. E. Neison; and a note on the boiling-point of methyl hexyl carbinol, by Dr. C. Schorlemmer, F.R.S.

Zoological Society, Dec. 1.—Dr. A. Gunther, F.R.S., in the chair.—A letter was read from the Rev. S. J. Whitmee, of Samoa, stating that he had sent home for the Society some birds and a pair of the Samoan Bat, which had lately been described by Mr. Alston as *Pteropus whitmeei*. Particulars were given as to the habits of the latter.—A communication was read from Mr. Henry W. Piers, of Capetown, containing remarks on some specimens of Gymnetrus in the museum at Capetown.—The Secretary announced that Col. R. S. Tickell, late of H.M. Indian Army, had presented to the Society's library a very finely illustrated MS. work, in seven small folio volumes, on the Ornithology of India.—A communication was read from Mr. J. Brazier, of Sydney, N.S.W., giving descriptions of eleven new species of terrestrial and marine shells from North-east Australia.—A paper, by Messrs. P. L. Sclater and O. Salvin, was read on birds collected by Mr. Whitely in Western Peru, being the eighth communication made by the authors on this subject.—A communication was read from Mr. H. Whitely, containing some further notes on Humming Birds collected by him in High Peru.—Mr. A. G. Butler read a paper in which he gave descriptions of three new species of homopterous insects from various parts of the world.—Mr. A. H. Garrod gave some further particulars on the mechanism of the "shew off" in the Bustards, and described the peculiar structure of the *frenum linguæ* recently noticed in a young male of the Great Bustard.

Royal Horticultural Society, Dec. 2.—Scientific Committee.—Andrew Murray, F.L.S., in the chair.—Models were exhibited of the fruit of *Stephanotis floribunda.*—The Chairman made a communication on the Larch disease. It appeared to produce a local destruction and ulceration of the cambium layer; the trees affected by it also suffered from "piping," *i.e.*, premature decay of the heart wood. The disease was now beginning to attack the Spruce and *Pinus excelsa.*—Prof. Thiselton Dyer exhibited part of the stem of a *Calamus* from Sikkim, in which the midrib of a sheathing leaf had produced an adventitious bud on its under side.—Dr. Denny raised a discussion on the possibility of superfœtation in plants.

General Meeting.—W. Lindsay, secretary, in the chair.—Prof. Thiselton Dyer commented on the investigations lately undertaken with respect to the potato disease. Prof. de Bary was disposed to believe that heterœcism occurred in the case of the potato parasite, that is to say, that part of its life was passed upon some other host besides the potato. Mouillefert had recently suggested that this might be clover, and Mr. Jenkins, secretary of the Royal Agricultural Society, supposed that both clover and straw might harbour the unknown stage of *Peronospora infestans*, and that this "would justify the prevailing opinion that farm-yard manure encourages the ravages of the potato disease, especially when applied in spring, because the spores of the fungus would be in the manure which had been used for litter."

Royal Microscopical Society, Dec. 2.—Chas. Brooke, F.R.S., president, in the chair.—A paper by Dr. Hudson, "On the discovery of some new male Rotifers," was read by the secretary, in the absence of the author. It described the male forms of Lascinularia, Floscularia, and Notommata, hitherto believed to be unisexual, and was illustrated by a number of very beautiful diagrams.—A paper by Dr. Schmidt, of New Orleans, upon the development of the small blood-vessels in the human embryo, was taken as read.

Victoria (Philosophical) Institute, Dec. 7.—The proceedings were commenced by the election of sixty-five new members and associates. It was stated that the total number of subscribing members was now 544.—Prof. H. Alleyne Nicholson, M.D., read his paper On the bearing of certain palæontological facts upon the Darwinian theory of the Origin of Species, and on the general doctrine of Evolution. The paper, after discussing the nature of the views usually held as to Evolution, examined in detail the difficulties which Palæontology offers to the acceptance of the Darwinian theory of the Origin of Species, and the arguments employed by Mr. Darwin to lessen or remove these difficulties.

EDINBURGH

Royal Society, Dec. 7.—Sir W. Thomson, president, in the chair.—The President delivered to Prof. Tait the Keith Prize for the biennial period (1871-1873), which had been awarded to him by the Council for a memoir published in the last part of the Transactions of the Society, entitled "First Approximation to a Thermo-Electric Diagram."—The President then delivered an address on "Stability of Steady Motion."

PARIS

Geographical Society, Nov. 18.—President, M. Delesse.—M. Vinot announced that an interesting discovery had been made on the summit of the Puy de Dôme, of the ruins of an ancient monument which seems to date from the first century after the conquest of Gaul by the Romans.—Dr. Hamy, in the name of M. de la Porte, chief of the last expedition to Cambodia, read a note containing interesting details concerning the country which he has explored. With the exception of a few principal points, Cambodia is in great part still unexplored. A new map of the country by M. de la Porte and M. Moura, representing the French protectorate in Cambodia, will shortly be published. M. de la Porte believes that many archæological discoveries of the highest importance are yet to be made in Cambodia, and he expects considerable results from the exploration about to be made by M. Harmand in the regions to the west of the French colony.

Academy of Sciences, Nov. 30.—M. Frémy in the chair.—The following papers were read:—Note on two properties of the ballistic curve, whatever may be the exponent of the power of the velocity to which the resistance of the medium is proportional, by M. H. Résal.—On the carpellary theory according to the Liliaceæ, by M. A. Trécul.—On the distribution of the bands in primary spectra, by M. G. Salet.—On the mechanism of the intra-stomachal solution of the gastric concretions of crabs, by M. S. Chantran.—M. Dumas called the attention of the Academy to the recent appearance of Phylloxera in Pregny, near Geneva, and M. Pasteur made some observations thereon. Letters from M. Schnetzler and M. Max Cornu to M. Dumas on the subject of Phylloxera were also read.—Letter from Mdme. V^e Bouchard-Huzard to the President, offering to the Academy documents relating to a great number of its members; documents composing the collection made by J. B. Huzard.—On the heat disengaged by the combination of hydrogen with the metals, by M. J. Moutier. The author has shown that the formula deduced by Clausius from Carnot's theorem for changes of state is applicable to dissociation. The formula is—

$$L = AT(v - v') \frac{dp}{dP}$$

L representing the heat of combination of two bodies at the absolute temperature T under the pressure p, equal to the tension of dissociation at that temperature, v the specific volume of the dissociated elements, and v' the specific volume of the compound under the same conditions of temperature and pressure. A is the thermal equivalent of work. From this formula the value of L can be found when we have tables of the tensions of dissociation of the compound at different temperatures.—The recent experiments of MM. Troost and Hautefeuille have made known these tensions for combinations of hydrogen with palladium, potassium, and sodium, at different temperatures.—Orbit, period of revolution, and mass of the double star 70 *p* Ophiucus, by M. C. Flammarion.—Observations of the zodiacal light at Toulouse, the 16th, 21st, and 23rd of September; 9th, 10th, and 11th Oct.; 10th and 12th of November, 1874, by M. Gruly.—Laws of double internal reflection in birefringent uni-axial crystals, by M. Abria. Researches on the decomposion of certain salts by water, by M. A. Ditte. In this third note the author has examined the double sulphate of potassium and calcium.—On the additive product of propylene and hypochlorous acid, by M. L. Henry.—Employment of gas-retort carbon in the distillation of sulphuric acid, by M. F. M. Raoult.—Influence of boiling distilled water on Fehling's solution, by MM. E. Boivin and D. Loiseau.—Iron in the organism, by M. P. Picard.—On experimental septicemy, by M. V. Feltz.—On the birth and evolution of *bacteria* in organic tissues sheltered from the air, by M. A. Servel.—Note on a stony concretion, by Dr. T. L. Phipson.—On some passages in "Stan. Bell," from which it may be concluded that *Amaranthus blitum* is cultivated in Circassia for the nitre which it contains; extract from a letter from M. Brosset.—Note on the lowering and natural elevation of lakes, by M. Dausse.—The compound flute during the reindeer period, by M. Ed. Piette.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—The Straits of Malacca, Indo-China, and China: J. Thompson, F.R.G.S. (Sampson Low).—Travels in South America: Paul Marcoy (Blackie and Son).—Supplement to Harvesting Ants and Trapdoor Spiders: J. Traherne Moggridge, F.L.S., F.Z.S., and Rev. O. Pickard-Cambridge (L. Reeve and Co.)—English Men of Science, their Nature and Culture: Francis Galton, F.R.S. (Macmillan and Co.)—Selections from Berkeley: Alex. Campbell Fraser, LL.D. (Clarendon Press).—Elements of Animal Physiology: John Angell (Wm. Collins.)—Elements of Magnetism and Electricity: John Angell (Wm. Collins).—Principles of Metal Mining: J. H. Collins, F.G.S (Wm Collins).—Evolution and the Origin of Life: H. Charlton Bastian, M.A., M.D., F.R.S. (Macmillan and Co.)—The Forces which carry on the Circulation of the Blood: Andrew Buchanan, M.D. (J. and A. Churchill).

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DIARY OF SOCIETIES.

LONDON

THURSDAY, DECEMBER 10.

ROYAL SOCIETY, at 8.30.—The Development of the Teeth of the Newt, Frog, Slowworm, and Green Lizard, and on the Structure and Development of the Teeth of Ophidia: C. S. Tomes.—On the Effect of Heat on Iodide of Silver, and on the Co-efficient of Expansion of a Paraffine of High Boiling Point: G. F. Rodwell.—Experiments showing the Paramagnetic condition of Arterial Blood, as compared with the Diamagnetic condition of Venous Blood: Dr. Shettle.—On the Multiplication of Definite Integrals: W. H. L. Russell, F.R.S.

SOCIETY OF ARTS, at 3.—Conference on steps to be taken to insure prompt and efficient measures for preventing the Pollution of Rivers.

MATHEMATICAL SOCIETY, at 8.—Two Letters from M Mannheim on Three and Seven Bar Motion. Communicated by J J. Sylvester, F.R.S.—On the Potentials of Polygons and Polyhedra: Prof. Cayley, F.R.S.

FRIDAY, DECEMBER 11.

JUNIOR PHILOSOPHICAL SOCIETY, at 7.30.—Arctic Exploration: David Gravell.

LONDON ANTHROPOLOGICAL SOCIETY, at 7.30 —Dolmens of Drenthe, Holland: Dr. Luboch —On the Scaphoid Skull of a Pole: Dr. Kopernicki.—On the Crania of the Round Barrows of a Section of the Yorkshire Wolds: Mr. Mortimer.—Certain Difficulties in Ancient Theologies and Modern Science: Dr. Inman.

MONDAY, DECEMBER 14.

GEOGRAPHICAL SOCIETY, at 8.30.

SOCIETY OF ARTS, at 8.—Cantor Lecture; Alcohol, its Action and Use: Dr. B. W. Richardson, F.R.S.

TUESDAY, DECEMBER 15.

STATISTICAL SOCIETY, at 7.45.—The value of Death Rates as a Test of Sanitary Condition: N A. Humphreys.

WEDNESDAY, DECEMBER 16.

METEOROLOGICAL SOCIETY, at 7.—Atmospheric Pressure and Rainfall: J. C. Bloxam.—Remarks on West India Cyclones: H. F Jahncke —Notes on the Weather experienced over the British Isles and the North-west of France during the first few days of October 1874: R H Scott, F.R S - On a New Self-Registering Hygrometer. H Negretti and J. W. Zambra.—Results of Meteorological Observations made at, and near, St. Paul's Island, in the South Indian Ocean: R. H. Scott, F R.S.

ROYAL SOCIETY OF LITERATURE, at 8.

SOCIETY OF ARTS, at 8. The Sandblast and its application to Industrial Purposes: W. E Newton.

GEOLOGICAL SOCIETY, at 8.—Descriptions of the Graptolites of the Arenig and Llandeilo Rocks of St. David's: John Hopkinson and Charles Lapworth —On the Age and Correlations of the Plant-bearing series of India, and the former existence of an Indo-Oceanic Continent: H F. Blanford. —On the Kimmeridge Clay of England: Rev. J. F. Blake, M.A

THURSDAY, DECEMBER 17.

LINNEAN SOCIETY, at 8.—Observations on Bees and Wasps: Sir John Lubbock, Bart, M P, F.R.S.—Diagnoses of New Genera and Species of Hydroida: Prof. Allman, Pres L.S.

CHEMICAL SOCIETY, at 8.—Grove's Method of preparing Chlorides: C S. Schorlemmer, F.R.S.—On the Precipitation of Metals by Zinc: J. L. Davies.

TORQUAY

MONDAY, DECEMBER 14.

NATURAL HISTORY SOCIETY, at 12, noon.—The Inscribed Stones and Ancient Crosses of South Devon: C. Spence Bate, F.R.S.

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TUESDAY, DECEMBER 15.

NATURALISTS' FIELD CLUB, at 8.—The Hedgehog: F. E. Prince.

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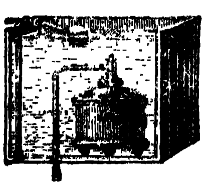

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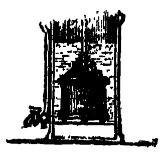

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THE TRANSIT OF VENUS

IT is not too early to congratulate the world of science upon a grand triumph. The telegrams which have of late been flowing in almost incessantly from all parts of the Northern Hemisphere—now from far Japan and from Siberia, recording the success of French, Russian, and American parties; and now from America, giving fuller details regarding the doings of the latter—leave no doubt whatever that the weather has been better at the northern stations than might have been expected, seeing that the observations have been made in the winter half of the year.

Nor has the Northern Hemisphere been the only one to give us news. We already know of success at Melbourne and Hobart Town, at which place was an American party similarly equipped to those at Wladiwostok in Asiatic Russia, and at Nagasaki; and Prof. Newcomb has already telegraphed to the *Times* that the eighty photographs taken by the American method at these places, combined with the 113 taken at Hobart Town, are sufficient to give us a value of the solar parallax with a probable error of perhaps one-fortieth of a second of arc. This gives a foretaste of what photography is likely to do for us in this and the coming Transit of 1882.

Before we proceed to detail the observations at the various stations, it will be well to re-state the various ways in which a Transit of Venus may be observed. This we will do almost in the words employed in a former article.

We have the utilisation of a Transit—

(*a*) By the determination of times of contact at different stations, combined with a knowledge of the longitudes of those stations.

(*b*) By the determination of the least distances between the centres of the sun and Venus during the Transit, observed from different stations.

This last determination may be made by—

(1) What is called Halley's method; or, if we wish that the world should forget a great work accomplished by a former great Astronomer Royal, we may term this the "method of durations."

(2) By the Photographic method; or,

(3) By the Heliometric method.

Premising that the first method of determination (*a*) was devised by Delisle, we have now our nomenclature sufficiently complete for present purposes, and we may begin with the stations at which this method can be *best* employed. Of these we have four groups: Accelerated Ingress, Sandwich Islands; Retarded Ingress, Kerguelen's Land, Heard or Macdonald Island, Mauritius, Bourbon, and Rodriguez; Accelerated Egress, Campbell Island, Emerald Island, Auckland Island, Royal Company's Island, and New Zealand; Retarded Egress stations in Western Russia, Persia, and Egypt.

Of these groups the northern ones can be used for Delisle's method solely, as only Ingress or Egress is seen; Ingress in the Sandwich Island group, Egress in the Western Asiatic group. But the southern groups may be used for all methods.

For the methods we have grouped under (*b*), stations in Eastern and Southern Asia, combined with those in the Southern seas which we have already named, and stations between them, such as Melbourne and Adelaide, may be employed.

From the Sandwich Islands, Kerguelen's Land, Heard Island, Mauritius, Bourbon, and Rodriguez we have of course not yet heard; we consequently know nothing of Delislean observations of Ingress.

Of observations of Accelerated Egress on this method we know nothing, but with regard to Retarded Egress we know that the English and Russian parties in Egypt have been wonderfully successful. At Teheran, a second class Russian station, but better adapted than Egypt for applying the Delislean method, the observations were a perfect success. At Ispahan, a German party obtained nineteen good photographs; but north of this, in the most favourable point of all, the Russian parties at Ormsk, Astrachan, and in all that region, there was complete failure.

From the English party several telegrams have been received since our last number appeared: a long one by the *Times*, and several shorter ones by the Astronomer Royal. These we give:—

"*Cairo, Dec.* 9.—The Transit of Venus was observed in all its phases by the astronomers of the Government Expedition in Egypt this morning, at the Central Station at Mokattam Heights. It was observed by Captain Orde and Mr. F. M. Newton at Suez, and by Mr. Hunter at Thebes. It was photographed by Captain Abney, and observed by Dr. Auwers and Prof. Dollen, also by Colonel Campbell and others. During the last three days the weather has been very bad, and this morning the telescopes in Cairo and Suez were directed to the eastern quarter of a sky clouded over, showing, however, a few breaks, which gave hope. Glimpses through the clouds exhibited Venus as a distinct black spot on the sun, but no opportunity was given for a micrometer measurement for nearly half an hour after sunrise; then a few chances were given through the openings in the clouds. A decided opening occurred of a very hopeful character about ten minutes before contact, and after one more cloud, which passed over two or three minutes only before the critical epoch, the observation of internal contact was made satisfactorily at every station in Egypt, and the photoheliograph has done its work well. The sky was quite clear for the measurement of cusps and any observations that could be made of external contact. The astronomers are satisfied with their observations. The phases are declared in Cairo to have so closely resembled those shown by Sir George Airy's model at Greenwich that it was hard to divest the mind of the idea that it was only model practice again. The Khedive has taken a warm interest in the work, and guarded the Mokattam station from intrusion by cavalry pickets. By means of the telegraph line he put up to Mokattam Heights, interchanges of telegraph time signals have been made between that station and Greenwich, Suez, and Thebes. This expedition has now, therefore, nearly completed its work, and in a few days will probably break up."

Capt. Ord Brown, R.A. (Mokattam), Dec. 9:—

"The egress of Venus was observed at Mokattam this morning. There has been much bad weather and anxiety. All well now. Contact seen through very slight haze with [the] Lee [Equatorial] at about 13h. 25m. 25s. sidereal, and with De la Rue 13h. 22m. 21s. (Observe in the Greenwich book of observation with the model; my egress is always after other observers, except Mr. Gill's.) Clouds spoilt much double image work, but many limbs and cusps were taken. The phases closely resemble those of the model, except a line of light round the planet's edge, which appeared with strong sun just after the above contacts. It perplexed me and made me lose my best cusps. When I found that it continued two minutes and that it would be so indefinitely, I turned to cusps. I have exchanged bad telegraph signals twice with Thebes, and good ones three times with Suez.—Mokattam Country, lat. 59° 58′ 14″."

Mr. Hunter (Suez):—

"Sky cleared partly a few minutes before contact. Contact satisfactorily observed, and a considerable number of micrometer measurements made."

Capt. Abney (Thebes):—

"Beautiful morning. Sun rather shaky at first, nice and sharp at time of contact, and good observations, though differing slightly in time. Sun pictures good. The fifty photographs in Janssen's slides include internal contact; external contact not taken. No black drop apparent in photographs after careful examination."

This, then, is all we know at present, or are likely to know for some little time, of the work done at purely Delislean stations. We now come to the stations at which the various methods of determining the least distance between the centres of the sun and Venus during the Transit, observed from different stations, are applicable.

And we may clear the ground by referring to the news from the southern stations first. From Hobart Town has come the best news in a telegram to the *Times*:—

"Prof. Harkness, of the American Transit Expedition at Hobart Town, reports, although the weather was bad, observations were particularly successful; 113 photographs were taken during the passage over the sun's disc."

We had previously heard of success from Melbourne and Adelaide; but these stations are not so well situated as Hobart Town, and it is doubtful if all the resources of a first-class fixed observatory, possessed by Mr. Ellery at Melbourne, will make up for his comparatively poor position.

We now come to that region where, in fact, the whole interest of the Transit has centred during the past week: to Asia and the adjacent Japanese Archipelago, neglected in the English arrangements even after the Board of Visitors of the Greenwich Observatory had very clearly indicated their opinion of the original official programme, by insisting upon the employment of the "method of durations" in the Southern Hemisphere. But, fortunately for the credit of English science, an English possession—India—has something to say in the Asiatic work. On the representation of Col. Tennant (who has done so much for astronomical science by his observations in India) of the importance of a station in the northern part of that country—a representation which was at once warmly received by the Viceroy—the Home Government at once took the matter up, and the result has been that a first-class observatory was erected at Roorkee. This was the Asiatic station from which news (which we chronicled last week) was first received.

But Northern and Eastern Asia was thickly studded with Russian, American, and French parties. In the Russian territory, Nertchinsk, Orianda, Charbarovka, Kiachta, Tschita, Port-Possiet, Wladiwostok, and many other places that we might name, were strongly occupied, and the wealth of results, whether in photography or heliometric measures, has been marvellous. One of these places—Wladiwostok—was occupied by an American as well as a Russian party. Herr Struve's telegrams to the *Times* regarding the observations at these places are as follows:—

"*Wladiwostok.*—Transit of Venus observed at both contacts, numerous chords and distances of the two limbs were measured.

"*Port-Possiet.*—Much clouds and mist; two interior contacts observed, and thirty-eight photographs taken.

"*Charbarovka.*—First two contacts and some chords observed.

"*Tschita.*—Contacts observed, and four series of measures with heliometer.

"*Orianda.*—Satisfactory observation of last two contacts.

"*Nertchinsk.*—Three contacts observed, and two diameters and twenty distances of the planet measured with heliometer.

"*Teheran.*—Full success of observations.

"*Thebes.*—Splendid weather; very important observations.

"*Kiachta.*—Much cloud; got only eight photographs.

"*Naratow.*—Clouds; complete failure.

"*Possiet.*—Photographs satisfactory after development, though taken through mist."

The work done by the American party at Wladiwostok, as stated in a Reuter telegram in the papers on the 11th, was as follows:—

"*Copenhagen, Dec.* 9.—Prof. Hall telegraphs from Wladiwostok to-day, at 10 A.M., that the observations of the Transit of Venus made at that place by the American party under his direction have not been very successful, on account of the hazy and cloudy weather. The first and second contacts were observed, and thirteen photographs were taken."

In Japan there were French parties under Dr. Janssen at Nagasaki and Kobe, an American party also at Nagasaki, and Russian and Austrian parties at Yokohama.

The telegrams giving the account of Janssen's work we must transcribe as they were received.

"*Nagasaki, Dec.* 9.—M. Dumas, Secretary Académie des Sciences and Minister Instruction, Paris.—Transit observed and contacts obtained. Fine telescopic images. No ligament. Venus seen over sun's corona. Photographs and plaques. Cloudy at intervals. Two members of our mission have made observations with success at Kobe."

"Transit observed at Nagasaki and Kobe. Interior contact, no ligament. Photographs revealed several clouds during transit. Venus seen over corona before contact. Gives demonstration of the existence of the coronal atmosphere."

The American party at Nagasaki has recorded its work in the following terms:—

"Day cloudy, but obtained second contact well—two observers; first and third contacts through clouds, and doubtful; 150 micrometric measures of cusps, separation of limbs, and diameter of Venus; thirty-one meridian transits both limbs, Sun and Venus; eighteen micrometric measures for difference of declination of limbs at meridian. About sixty good photographs. Ends threatening rain. Telegraph difference of longitude with Wladiwostok in November. All well."

The following is a copy of another telegram to the *New York Herald*:—

> "*Wladiwostok, Siberia, Dec.* 9 (10.10 M.E.).—Prof. Hall reports much haze and cloud at Wladiwostok. First and second contact of Venus observed, and thirteen photographs taken near middle of transit. A calm bay, with temperature 34°; instruments and photographic apparatus working finely. All the American party working well."

The Russian and Austrian parties give no details; they only announce their success.

There is now a certainty that in the Southern Hemisphere the eastern stations will be more strongly occupied than the western ones. The Americans were foiled in their gallant attempt to occupy the Crozets, because they had not time to wait for weather moderate enough for them to land their instruments. The party has therefore gone on to Campbell Island, where they will already find a French party. It is difficult to restrain one's pen when we think of the combination of want of a true appreciation of the conditions of the problem, and want of that old spirit which used to make us take up posts of difficulty, which has prevented England being represented here. A successful Polar Expedition will scarcely wipe away the national disgrace which is ours in consequence of official action in this matter, and the French and Americans may well be proud of the position they now occupy.

The *Times* thus relates the French landing on Campbell Island:—

> "A letter has been received to-day (Dec. 11), dated Campbell Island, Oct. 4, from the chief of the French Expedition stationed there. This had been carried to Bourbon by the ship which had transported the expedition to Campbell Island, and which left it to wait at Bourbon until the time came for fetching the astronomers away. The first idea was to keep this ship off the coast of Campbell Island in order that the observers might live on board; after struggling three days against horrible weather they at last landed on the island, and they soon perceived that it was impossible to keep the ship off the shore, which was without shelter and exposed to terrible gusts of wind, so that it ran the greatest risk of being lost. The members of the expedition, seeing that if the ship were to go down they were exposed to very serious danger—for they would be abandoned on an uninhabited island without means of communication, while everybody would think they still had the ship at their disposal—decided to unload the ship and establish themselves in the island and to send away the vessel, which would come and fetch them immediately after the observation of the phenomenon. This project was carried out. The observers began by organising temporary shelter, and then they built sheds to protect the instruments, the necessary utensils, and the provisions. The process of unloading was very long and troublesome, because the expedition, which has many members, had brought provisions for one year. While exploring the island they found nearly in the middle of the island a vessel which a hurricane had thrown there, and they were thinking of utilising the wreck, either by splitting it up or by placing themselves inside it, for protection against wind and weather. But two or three days afterwards another hurricane blew the ship out to sea, and they saw it no more. They were then obliged to do the best with all they had brought with them, for they were living in hourly dread of sharing the fate of the wreck.
>
> "It is thought that since the 4th of October, the date on which the ship left for Bourbon, up to the moment of the transit, the expedition will have completed its organisation, its observatories, and have been able to fulfil its mission. As soon as the ship reaches a telegraphic station, the expedition will hasten to communicate particulars to the Institute of France. Nothing is known, of course, as to the exact period when these communications will be received. The particulars relative to the difficulties of this expedition and the dangers to which it is exposed have been received here with all the more interest that it was feared only two days ago that the Campbell Island station would not be organised in such a way as to make the observations under favourable conditions. It is still feared the weather may not have been favourable, and that so much fatigue and effort may not have been rewarded with the magnificent result it deserves."

It will be seen not only that a large number of observations have been made bearing on the main point, but that many side issues of great interest are raised. Dr. Janssen's observations have decidedly been amongst the most remarkable, not only with regard to the absence of the ligament, but as touching the visibility of Venus on the coronal atmosphere. Any detailed reference to these and many other points we must, however, leave for a subsequent article. We have been anxious in the present one to put our readers in possession of the results of the observations, so far as we at present know them, in the most authentic and intelligible form.

CHAPPELL'S "HISTORY OF MUSIC"

The History of Music. Vol. I. From the Earliest Records to the Fall of the Roman Empire. By William Chappell, F.S.A. (London: Chappell and Co., 1874.)

MUSIC is now being cultivated in a much more earnest and thorough manner than heretofore, not only as a practical art, but as a matter of theoretical and historical interest, as is evidenced by the late formation of a "Society for the study of the Art and Science of Music," the object of which is to encourage musical studies of a higher character than those comprised in ordinary musical training. Hence, as the early history of music is one of the most interesting as well as one of the most obscure topics connected with the art, an authoritative new investigation like that before us is of real value.

Mr. Chappell, who has had much to do during his life with practical music, brought out some years ago a "History of the Ballad Literature and Popular Music of the Olden Time," a book which has become now of standard authority on such matters. It seems that the eminent historian Mr. Grote suggested to him that he would do well to carry his inquiries further back, and to attempt to unravel the state of music among the Greeks. His account of his progress is worth extracting. He says:—

> "Mr. Grote's enthusiasm for the Greeks somewhat exceeded mine; and, although my recollection of the language was fresher than now, I did not suppose that, even if I should succeed, a knowledge of Greek art and science would greatly advance those of the moderns; therefore I received the proposal rather lukewarmly. But when favoured with the twelfth and last volume of the 'History of Greece,' with an inscription from the illustrious author, in deference to his long antecedent recommendation I took the first step forward, by buying the works of the Greek writers upon music.
>
> "I had taken note of the odd uses of Greek words in manuscripts of the Middle Ages written in Latin; there-

fore, while reading the Greek authors on music, I continued to copy out such definitions of musical terms as I then encountered. I began without expectation of success as to understanding the music of the Greeks, owing to the number of able men whom it had baffled; but my little glossary seemed to afford the clue, and soon made me interested in the subject. It became evident that the Roman perversion of Greek musical terms had been one of the great difficulties in the way of previous inquirers (although by no means the only one), for I could then understand the system."

All this confirms the character of the author as an earnest, painstaking inquirer, and affords therefore a guarantee for the value of his historical investigations.

Mr. Chappell comments on the two great English musical histories of the last century by Burney and Hawkins, and contends that much of the obscurity in which they left the ancient music was caused by their obtaining their information second-hand, namely, from Boëthius and other commentators, chiefly Latin, on the Greek writers. Many of these had not sufficient knowledge of the subject to understand the original technical terms, which they therefore rendered either erroneously or obscurely, and thus error and obscurity have been introduced into succeeding writings.

"It may," says Mr. Chappell, "at first appear unaccountable that, among the numbers of learned men who made the attempt to understand the Greek system during so many ages, no one should have succeeded, especially considering that it would hereafter be shown, even to the quarter-tone, to be our modern system of music. So simple a result seems ludicrous. But this general failure is to be accounted for by the fact that the Romans had twisted round the meanings of the Greek words in so extraordinary a fashion that perhaps 'tone' and 'diatonic' are the only two which remain nearly identical in the two languages. So that, to unriddle the subject, the student had first to unlearn all that he had been taught as to the meanings of musical terms, and then to begin again, trusting only to the Greek authors. No Latin treatise would avail, nor would any modern language in which musical terms had been derived through the Latin, or through the Western Church. The misuse of Greek technical language by Romans was by no means limited to music."

To eliminate these errors, the author tells us, and we believe him, that he has in every case, where possible, gone to the fountain head, and that the information he gives us may consequently be depended on.

We have thought it right to show at some length what are the author's qualifications for his work, and on what grounds he lays claim to our attention and credence; for, in *historical* works this is all-important; few of us have opportunity, and still fewer have inclination, to grope for ourselves among the mouldy lore of antiquity; we are glad enough to find others who will do it for us, and are ever ready to take as authentic whatever they tell us they have found there. Hence correctness and care are cardinal virtues in historical works; the want of these qualities renders such works worse than valueless, as merely promoting the dissemination of error.

The history of music, interesting as it is, is not, properly speaking, a subject to be treated of largely in NATURE; but, in justice to the meritorious author, we may venture to mention some of the results of his labours.

In the first place, he shows that the system of music used by the Greeks did not originate with them, but was borrowed from more ancient nations. He finds, for example, that "the number of notes in the Egyptian scale was precisely the same as the Greek, including the three Greek scales, diatonic, enharmonic, and chromatic." No Greek writer alludes to any difference between the Egyptian and Greek systems of music, although the best Greek works on the science of music, saving the Problems of Aristotle, were written on the soil of Egypt." Then he turns to the Chaldæans, or learned men of Babylon, and again finds (through an astronomical comment which, as usual, supposes the motion of the planets to be regulated by musical intervals, and thus to make everlasting harmony) that the Chaldæans had the same musical intervals of fourth, fifth, and octave, as the Egyptians. From these he was led to Hebrew music; remarking that proofs are not wanting of the similarity of this to the music of surrounding nations; so that "henceforth we may fairly conclude that we have at last arrived at the musical system of ancient Asia, and that it is our A, B, C, D, E, F, G."

The author, of course, enters largely into the progress of music in Greece. We read of the early tetrachord lyre, of its enlargement by Terpander; of the great improvements made by Pythagoras in the addition of the octave, the fifth, and other notes; of his important determination of the proportions of the lengths of strings, subsequently transmitted to posterity by the great geometer Euclid; of the chromatic and enharmonic scales, hitherto so perplexing; of the improvements in certain harmonic ratios made by Didymus and Ptolemy, and so on; from all which we undoubtedly gather a far clearer view of what Greek music was than can be obtained from either of our English histories.

The result is that the ancients anticipated almost exactly the diatonic scale of modern times. Their scale passed over to the Latins; it was adopted without change by the early Church; and by this means it has come down, unaltered, to our time. If we run up two octaves on the *white* keys of the modern piano, beginning and ending with A, we are playing the same notes as the Greeks used, any time after Pythagoras. We may add that if we use only the *black* keys (and many modern tunes may be thus played), we sound a scale precisely corresponding to one of the Greek "chromatic" genera.

The scale, be it remembered, is the *material* from which music is made. To discover what sort of melodies the ancients constructed from this material is another thing. Mr. Chappell has, however, presented us with three real Greek tunes, set to hymns to Calliope, Apollo, and Nemesis respectively. They have been, it is true, decked out, by the skilful aid of Mr. Macfarren, in an anachronous dress of modern harmony and rhythm, suggesting the idea of Pythagoras in a periwig; but, at any rate, they are no more incongruous in this respect than the so-called "Gregorian" chants, as sung with modern embellishments at a Ritualistic church-service.

The question has been often and warmly discussed whether the ancients used what we call harmony, or whether they did anything analogous to our singing or playing in several parts. Our author believes that they did, but in this matter he has not the argument all his own way. The late M. Fétis, who devoted the last years of his life to the preparation of a great History of Music,* has made a most elaborate investigation of this point, partly in the third volume of his work, and still more fully in a separate memoir published by the Academy of Sciences of Brussels. It is ably and forcibly argued, in opposition to many learned German critics who have held Mr. Chappell's view, and M. Fétis arrives at the conviction that "the supposition of the existence of harmony among ancient nations is one of the most remarkable extravagances of modern times." Mr. Chappell is very positive in his own opinion, but when we come to compare the two essays we cannot help seeing what a poor match his desultory guerilla argumentation is for the powerful disciplined logic of his more experienced antagonist, and cannot hesitate for a moment which side should prevail.

But even if we were inclined to believe with our author that the ancient Greeks did use some sort of harmony (other than the octave, which M. Fétis freely allows them in common with all nations), we are not much the forwarder: for even Mr. Chappell appears quite at a loss to form any reasonable idea of what this harmony was like. After all, therefore, the dispute is little more than "'twixt tweedle-dum and tweedle-dee."

The subject of ancient *musical instruments* is as important and as interesting as that of the music itself: and, indeed, they have in all ages had such a necessary connection, and have been so dependent on each other, that improvement in one has gone hand in hand with improvement in the other.

Mr. Chappell has devoted much attention to the evidence as to the nature of the instruments used in ancient times. This, he says, has always been found a difficult subject to treat upon, partly because so few of the instruments named by classical writers can be identified by pictorial or written descriptions, and partly because such descriptions, when they do exist, are often obscure or contradictory, particularly when obtained only through the medium of incorrect translations. He goes through a long list of ancient instruments of the three classes—wind, percussion, and string—and has given a large fund of information about them.

But what he prides himself most upon is the elucidation of the construction of the hydraulic organ, about which there has hitherto been much doubt and difficulty. He shows that this has arisen either from misapprehension of the ancient descriptions or from a want of sufficient knowledge of mechanism to understand the technical details; and he gives, in a most interesting chapter, an account of the instrument, which evidently presents a high claim to be the true one. In this particular we are delighted to award him the merit of a real triumph over his enemy, M. Fétis, who says, after speaking of the ambiguity of the description of the instrument left by Vitruvius:

> "Sous ce rapport l'incertitude persiste, et tout porte à croire qu'elle ne sera jamais dissipée, à moins que le hasard ne fasse découvrir un des instruments du mécanicien d'Alexandrie, dans les recherches faites à Pompeii."

If it were only for his solution of this difficulty, Mr. Chappell's work deserves high praise.

We cannot expect every historian to be a Gibbon or a Hume, and though we readily testify to the merits of Mr. Chappell's work, we are obliged to say it is not without its faults. One is the tendency of the author to be diffuse and discursive in his style, to such an extent, indeed, as to give the work the character rather of an amusing gossip than of a serious history.

Another of Mr. Chappell's peculiarities is his strong tendency to over-confident dogmatic assertion, which renders it often difficult for the reader to distinguish between statements he has evidence for, and mere opinions of his own. Every writer on history should remember that on that subject dogmatism is utterly out of place: no man's *ipse dixit* is worth the paper it is written on: if he cannot or will not show chapter and verse for all he has to say, he had better let history alone. Hypotheses and speculations on obscure points are all very well; they are often useful for discussion, and sometimes turn out right; but they must be put forward clearly as what they are, and not given as truths.

Mr. Chappell has a high opinion of his own qualifications for his work, which is quite pardonable; but this is unfortunately coupled with an unduly low estimate of the competency of other historians, which is not pardonable. His contemptuous sneers at M. Fétis, for example, are in the worst taste; and if the Nestor of musical literature were alive to reply, we would not be in Mr. Chappell's shoes for a trifle. As it is, did it never occur to him that, as M. Fétis's history has now a wide circulation, and is becoming, in fact, the European standard book on the subject, readers who have access to both works might be tempted to retaliate by comparisons not altogether in favour of the English historian? Those who live in glass houses should not throw stones.

We have alluded above to an anachronism in the form in which Mr. Chappell has presented some of the Greek tunes. There are other analogous cases where he produces confusion by ascribing to the ancients ideas that have only arisen in modern times. He talks, for instance, often of the *key* and the *key-note* of Greek music. Does he mean to assert that any ideas existed in those days analogous to what we understand by these terms now? And when he sees, in an ancient picture, a man shown clapping his hands, he calls him a "conductor beating time." Had Sir Michael Costa really a prototype among the Egyptians, who gesticulated four in a bar?

We wish we had no worse faults to find than these, which are, after all, only peculiarities of style (and *le style c'est l'homme*); but unfortunately there is one part of the work which, as it affects the interests which it is the peculiar object of NATURE to promote, we are bound, though most reluctantly, to speak strongly on. The followers of Zoroaster hold that every man is subject to the alternate influence of two spiritual agencies, one prompting him to good, the other inciting him to evil. Ormuzd (we think that is the name) has been active with Mr. Chappell, leading him through the pleasant pages of Aristotle and Plato, and dictating to him all the agreeable matter in which we have been delighting, while the serpent-like Ahriman has been looking grimly on. But, the history ended, the turn of the evil tempter has arrived, and the good angel has retired, veiling his face with his wing, and dropping (if angels can weep) a tear over the calamity which he had no longer power to avert.

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* "Histoire générale de la Musique, depuis les temps les plus anciens jusqu'a nos jours." Par F. J. Fétis. Paris: Firmin Didot. Four volumes of this are now ready, bringing the history down to somewhat later than the time of Guido d'Arezzo; and, we understand, materials have been left for still more.

In plain language, Mr. Chappell has been minded, in an evil hour, to wander away from his legitimate domain of Ancient History, and to indite a long disquisition on the by no means kindred subject of Modern Science, treating especially on the laws and phenomena of acoustics, and their bearing on the nature and relations of musical sounds. In this his aggressive spirit is again manifested. All scientific men interested in the theory of music know that within the last few years Prof. Helmholtz, of Heidelberg, one of the first physicists of Europe, has brought out a work, "Die Lehre von den Tonempfindungen, als Physiologische Grundlage für die Theorie der Musik," which, for the profundity of its knowledge both of the physical and musical elements of the question; for the novelty and importance of its views; for the skill and conclusiveness of its experimental demonstrations; and for its general masterly style, has deservedly excited the admiration of all Europe. It has gone through three editions in Germany, has been also published in French, is now being translated into English, and has served as the basis already of several other English works, the author of one of which describes it as "a profound and exhaustive treatise, which does for acoustics what the Principia of Newton did for astronomy." Now, Mr. Chappell presumes to criticise this work in a tone which clearly shows not only that he is unaware of the reputation of its author, but that he is under some strange hallucination as to his own qualifications for setting up as judge in the matter. He attributes to Helmholtz both theoretical ignorance and experimental error; puts forward his own confused notions as "the *true* (in offensive opposition to Helmholtz's *false*) physiological basis for the science of music;" and sums up with the following paragraph, which, comparing the scientific position of the two writers, may certainly be considered a curiosity of criticism:—

> "I am persuaded that the *Tonempfindungen* is a hasty book . . . . the value of time was too largely considered in its composition, and some very necessary experiments, such as those upon harmonics, were omitted. But since success has been so widely attained, it may be hoped that the author will find time to revise the next edition, and, in doing so, that he will bear in mind an admirable motto for men of science, *Chi va sano, va piano.*"

A HASTY BOOK!—why, its very first sentence states that it is the result of *eight years' labour!* Experiments on harmonics omitted!—why, they form the substance of the entire book, from beginning to end! From these, and many other misapprehensions of Mr. Chappell's, we are led to doubt whether he can even have read the great work he ventures so freely to criticise.

Prof. Helmholtz has always maintained cordial relations with this country, and in the name of English science we think we owe him an apology that anything like this should have appeared in our language under a quasi-scientific guise. He will, however, know that historians may rush in where philosophers would fear to tread, and we need hardly assure him that no English scientific man, competent to judge of his work, [illegible] be in the least likely to endorse Mr. Chappell's criticisms.

We lament Mr. Chappell's mistake on another ground. Practical musicians have generally but little knowledge of the scientific data on which their art depends; such information is never taught in England to professional students as any part of their musical education; it is studied almost exclusively by men of science and amateurs. All [illegible]-minded persons would gladly desire to promote the wide spread of knowledge of this kind; but we cannot but feel that when a practical musician takes it into his head to attack scientific authorities who are universally respected, and scientific doctrines which are universally established, a great obstacle is thrown in the way of that cordial sympathy and co-operation which ought to exist between the two classes. On the one hand, the scientific man will be angry at the perverse [illegible]teachableness of the musician; while, on the other hand, the musician, who may easily mistake error for truth, will be set against the theorist and be more disinclined than ever to receive information from him.

It would be an ungracious [illegible]k to point o[illegible] in detail Mr. Chappell's errors; we wo[illegible] rather recommend him, instead of waiting for Prof. Helmholtz to "revise his next edition," to read the work as it is, more thoroughly and carefully, and with more respect for the character of its author. And in the meantime, out of sincere good will, we earnestly advise him to expunge all this irrelevant matter; it not only damages his valuable book, but, what is worse for him, it tends to engender in the minds of the best class of readers a want of confidence in his judgment and accuracy as regards other things.

FOSTER AND BALFOUR'S "EMBRYOLOGY"

The Elements of Embryology. By M. Foster, M.A., F.R.S. and Francis M. Balfour, B.A. Part I. (London: Macmillan and Co., 1874.)

"STEP by step the simple two-layered blastoderm [of the hen's egg] is converted into the complicated organism of the chick." The separate cells of which it is originally composed have, to all appearances, the most uncomplicated relations one to another; nevertheless, in accordance with laws of which we have not the least conception, under the influence of slight external warmth, by a series of fissures, inflections, and developments in special directions, they convert the [illegible]re of albuminous material that, together with them, [illegible]cluded within the egg-shell, into an organism so ela[illegible]e as a fully developed bird, which can run about and feed itself immediately it makes its appearance in the theatre of active life. The physicist, thoroughly acquainted as he may be with all the principles of statics, dynamics, heat, light, and electricity, finds himself quite at a loss to explain or to predict any single one of the numerous changes which have taken or will take place in this blastodermic membrane during any period, however short, that it has been the subject of observation. Neither the chemist nor the physiologist will find himself in any more advantageous position, except that the latter, from previous experience, will be able to state dogmatically the succession of the steps of the developmental process. We group these phenomena, apparently so extra-physical, under the term "vital"; and if at any time it should [illegible] shown, which is well within the region of possibility, that they depend on the manifestation of a force other than one of those with which we are at present acquainted, the disciples of the "vitalistic" school will have reason to exult over those "physicists" who do not admit the existence of any yet undiscovered mode of motion. As yet, the fact that one's parents in their earliest days went through the same changes as oneself is not considered a sufficient basis for any logical hypothesis on the subject of the progressive development of one's constituent elements.

Again, since the time of Von Baer, the [illegible] parallelism which is so continually observed between the various development-stages of living beings considerably removed from one another in the scale of zoological affinity, has made the study of embryology an essential part of the science of Comparative Anatomy; in other words, the whole life-history of the individual, and not only the period of maturity, is now known to be necessary for our accurate comprehension of the pedigree of the animal kingdom, in the same way that it may be considered to reflect it. This conception has of late borne fruit in the all-embracing hypotheses of Prof. Hæckel and Mr. E. Ray Lankester, as well as in the new classification of the animal kingdom so recently promulgated at a meeting of the Linnean Society by Prof. Huxley (NATURE, vol. xi. p. 101). It may, however, be mentioned that there is a limit to generalisation in this direction; for the theory of natural selection allows us to assume that some of the forces which come into play to produce variation in the individual, and therefore generally, may do so at the very outset of embryonic life; and, if they do so, differences from the ancestral type may then appear in all the embryonic stages from the commencement. Such a view of the question helps to explain otherwise most involved subjects, such as the existence of "gastreæ" of two entirely different types; the development of the notochord from different layers of the blastoderm in different groups of animals; and other varying features of early embryonic life.

These remarks all indicate how large a field is opened up for the student of every branch of natural science [illegible] the study of embryology; and it is evident that before any considerable progress can be made in any of the many intricate problems involved, a minute acquaintance with the fundamental facts of development is indispensable. The work before us is the first systematic attempt which has been made in this country at least, to place the whole subject on the required footing; and in how satisfactory a manner this has been accomplished will be attested by all who have taken the opportunity of studying it. When supplemented by the other two volumes promised by the authors in their preface, it will form a complete history of the most important changes known to occur during the embryonic life of the different groups comprising the animal kingdom. For a long time past such a work has been a great desideratum, the monographs of different authors are scattered over a whole library of books; many who require to employ the known results have but little time to investigate each sufficiently to form a sound opinion of their own, and fewer still are able to prosecute the somewhat special line of investigations on their own account. All working biologists, therefore, owe much to Dr. Foster and Mr. Balfour for the great care they have taken to sift the literature of the subject, as well as for their independent investigations, which add so considerably to our knowledge of a branch of biology which has but little attracted the attention of our own countrymen.

To turn to the subject-matter of the work itself. There are advantages possessed by the hen's egg, found in no other vertebrate embryo, which have led the authors to take the *history of the chick* as the starting-point for their subsequent descriptions. It is "the animal which has been most studied, and the study of which is easiest and most fruitful for the beginner." This must be evident to anyone who has had the least experience. A chronological order is followed, in which the changes which occur day by day, and sometimes even hour by hour, are fully traced through the earlier days of incubation; the incidents of the later days being much more briefly summarised, because they pertain more to the bird as a bird, than to it as a member of the sub-kingdom Vertebrata.

As above remarked, but little of the embryological work which has been undertaken since the time of the illustrious Harvey has been conducted in this country; it is therefore not to be wondered at that we are far behind the times regarding [illegible] important points which for some time past have [illegible] familiar to foreign investigators, mostly German, and [illegible] insufficiently laid stress on, or are omitted altogether, [illegible] embryological treatises and text-books. Among these may be mentioned the evanescent nature of the "primary groove" in the mesoblastic layer of the blastoderm, and its replacement by the "medullary groove," [illegible] which alone, and not from the former, the spinal canal is subsequently formed. "The primary groove, then, is a structure which appears early, and soon disappears without entering directly into the formation of any part of the future animal. Apparently it has no function whatever. We can only suppose that it is a rudiment of some ancestral feature," remark our authors.

The much-debated subject of the development of the blood-vessels and corpuscles is entered into in detail, and fresh investigations by one of the authors are recorded, which agree in many respects, as they remark, with those of Remak and Klein. The vessels are shown to be [illegible] the union of processes sent out from the meso[illegible] the pellucid area. The nuclei of these cells [illegible] break up into numerous small ones, the [illegible] which acquire a red colour, and become con[illegible] blood-corpuscles; whilst the rest, changing into a spindle-shaped form, develop into the synovial lining of the blood-vessels.

Another point of special interest is the development of the permanent vertebral column. As all know, the protovertebræ are developed at the sides of the notochord, with a neural arch attached mainly to the posterior end of each; whilst the root of a spinal nerve occupies the anterior portion. "On the fourth day the transparent lines marking the fore and aft limits of the protovertebræ are still distinctly visible. On the fifth day, however, they disappear, so that the whole vertebral column becomes fused into a homogeneous mass whose division into vertebræ is only indicated by the series of ganglia. This fusion . . . is quickly followed by a fresh segmentation, the resulting segments being the rudiments of the *permanent* vertebræ. The new segmentation, however, does not follow the lines of the earlier division, but passes between the ganglionic and the vertebral portions, in fact, through the middle of each protovertebra. In consequence, each spinal ganglion and nerve ceases to form the front portion of the primary vertebra formed out of the same protovertebra as itself, but is attached to the hind part of the permanent vertebra immediately preceding. Similarly, the rudiment of each vertebral arch covering in the neural tube, no longer springs from the hind part of the protovertebra from which it is an outgrowth, but forms the front part of the permanent vertebra, to which it henceforward belongs. . . . . By these changes this remarkable result is brought about, that each permanent vertebra is formed out of portions of two consecutive protovertebræ."

Such being the case, the question suggests itself as to what becomes of the portion of the new column corresponding to the anterior or cephalic end of the protovertebræ nearest the skull which has no other semivertebra wherewith to blend. It has no neural arch, and does not enter into the formation of the cranium, for the protovertebra does not enter that complicated structure. We are not informed as to its destination. May it not be that it persists as the odontoid process of the axis, which, from not being able to maintain an independent existence, joins, late as we know, the second cervical vertebra? This hypothesis involves a difficulty, no doubt, as to the nature of the atlas, but seems to throw some light on the peculiarity in the conformation of the axis.

The development of the vascular system, through the various complex stages, is most fully explained, with the assistance of several very instructive diagrams. We can hardly help having a feeling of regret that the common fowl does not resemble its allies, the Mound-makers (*Megapodidæ*), in having only a single carotid artery instead of two, because then we should have the question answered as to the method by which the companion vessel is lost, which is at present not in the least understood.

We must refer our readers to the work itself for an account of points so important as the development of the Wolffian bodies and their ducts, the spinal cord, the heart, the nasal pits, as well as the many other details respecting the different organs which go to form the adult bird; original observations will be found on most; and where these are absent, the excellence of the *résumé* of the work of others will clearly prove with what conscientious care the authors are carrying out the evidently pleasurable labour they have imposed upon themselves. As far as the permanent kidneys are concerned, it must be mentioned that, from their manner of development, it is shown that their separation morphologically from the Wolffian bodies is an occurrence of *purely secondary importance.*

Now that we have a text-book of embryology produced under such favourable auspices, it is to be hoped that the far-spread ignorance on that subject, which is at present but too apparent on all sides, will no longer exist, and that a higher standard whereon to commence further investigation will quickly develop itself amongst all English students of biology.

A. H. G.

OUR BOOK SHELF

A Monograph of the Post-tertiary Entomostraca of Scotland. By G. S. Brady, H. W. Crosskey, and D. Robertson. (Palæontographical Society.)

In this part of its publications the Palæontographical Society has done good service to that large body of geologists who take interest in the story of the old glaciers and icebergs of Britain and love to gather when they can the traces of the life which peopled the frigid sea once spread over some of the richest tracts of our present islands. The descriptions here given of the localities and sections of the glacial deposits are perhaps all that could be at present attempted, but they offer a very puzzling problem to the reader who would fain know something of the chronology of the deposits. Nothing can show more satisfactorily the labour which has in recent years been bestowed upon these Post-tertiary clays than the fact that a few years ago not one of the minuter forms of Crustacean life had been noted as occurring in them, while now more than 130 species belonging to twenty-seven genera of Entomostraca have been carefully examined and described by the authors of this Monograph. The names of Brady and Robertson are a sufficient guarantee for the faithfulness of these descriptions, while Mr. Crosskey's knowledge of the localities and his expertness as a collector have given an additional fulness and value to the Monograph. Though but dry reading for ordinary people, these pages, with their accompanying admirably executed plates, will be a valuable boon to many a student of Post-tertiary geology.

The Races of Mankind: being a Popular Description of the Characteristics, Manners, and Customs of the Principal Varieties of the Human Family. By Robert Brown, M.A., &c. Vol. II. (London: Cassell, Petter, and Galpin. *No date.*)

This work, which seemed in the first volume to promise some scientific value, is now down to the level of the popular picture-book. There are some good pictures in it, and no doubt the boys and girls who have it given them will pick up ideas from its compiled information. We have not done more than look into it here and there, finding errors small and great. At p. 4, a Spanish-American is called, with curious felicity of blundering, "Don Jose Marie del Muchos Dolores." At p. 22 we read, "The smallest shopkeeper in Germany expects to be addressed as Mr. Court-Councillor." At p. 284 is a picture of a Bushman playing on the goura, or musical bow. This appears to be an altered copy of the illustration in Mr. J. G. Wood's "Natural History of Man," vol. i. p. 295; but whereas Mr. Wood's artist knew that Bushmen have narrow heads, and drew his accordingly, the present draughtsman, by his alteration, has given his native a skull of enormous width. At p. 113, in contradiction to the weight of ethnological evidence, the Australians and Tasmanians are treated as belonging to the same race. When we add that many of the illustrations are taken without acknowledgment from Figuier's "Human Races," it is not necessary to inquire further where M. Figuier got them.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

The Royal Agricultural Society and the Potato Disease

My main object in writing to you was to correct what Mr. Jenkins admits were "grotesque statements," and to claim for a distinguished English botanist credit for work done by him thirty years ago, which I was unwilling, without protest, to see assigned to anyone else.

No doubt the Royal Agricultural Society was not founded for the advancement of science in general or of botany in particular. When, however, it transcends the practical limits it has imposed upon itself, and promotes a purely scientific investigation, the way it sets about it is, I suppose, a fair object of criticism in a scientific journal.

Mr. Jenkins complains that I have not taken the trouble to read the official reports published by the Society, and thinks my criticisms upon them might have had some value. As a matter of fact I have done so, and my difficulty is to be quite sure that I understand what the last and most important really means. To say nothing of the occurrence of "jonidia" for "conidia," I find the following sentence:—"Prof. de Bary expresses sanguine hopes that he has at last discovered the certain nids (*sic*) or resting-places of the oospores or active primary germs of the fungus." It would not have occurred to me to describe oospores—in other words, resting-spores—as *active*, and it has been suggested to me as not impossible that oospore may also be a misprint in place of zoospore. There is the more necessity for caution in the matter, as the publications of the Royal Agricultural Society do not seem to receive the botanical revision that might have been expected. Only last year—and it was not a solitary blunder—a fungus was figured in the Society's Journal as Aspergillum (*sic*), which was obviously no Aspergillus at all, but the common Bread-mould (*Ascophora Mucedo*). No doubt, in due course, we shall have the opportunity of reading, at full length, what Prof. de Bary has added to our knowledge of the matter; but in the meantime we should not forget what is due to those who have already worked at the subject in this country.

Mr. Jenkins denies that the Society offered prizes for disease-proof potatoes. I find that in the report of the judges on the abortive essay competition, presented to the Council, Dec. 10, 1873, it was recommended, "That valuable prizes be offered for (*a*) The best disease-proof early potato; (*b*) The best disease-proof late potato." Again, the recently published official report to which I have already referred commences: "The judges appointed to inspect the growth of the six varieties of potatoes, *which were entered for competition as disease-proof*," &c. It may be that this is "colloquial" language, and does not mean what it says; but Mr. Jenkins must know that if by any chance any one of the potatoes tried had run the gauntlet of the three years' trial, it would have been advertised far and wide as stamped with a "disease-proof" character by the Royal Agricultural Society.

Mr. Jenkins complains that I suggest an offensive spirit as actuating the Society in its communications with Prof. de Bary. I can only say that I used the Society's own language. I find that the judges, in their report, *after declining* to recommend any one of the ninety-four essayists for a prize, propose "That a sum of money (say 100*l.*) be granted *for the purpose of inducing* a competent mycologist to undertake the investigation of the life-history of the potato-fungus" (as if nothing had been done in it already). The joint Botanical and Journal Committee thereupon gave notice that they would ask for a grant of 100*l.* to carry out this recommendation. I am not aware that the British Association proceeds in this way in distributing its funds, and I leave Mr. Jenkins to reconcile what I have quoted with his statement, "that the *first* step taken by the Council of the Society was to direct me to write to Prof. de Bary."

Let me sum up the substance of my criticisms. The potato disease has been before the scientific world for thirty years, and has been investigated by Berkeley in England, Montagne and others in France, De Bary in Germany. The Royal Agricultural Society takes charge of a competition which induces ninety-four persons to write on a subject on which it was *à priori* in the last degree improbable that they could have any really important unpublished facts to bring forward within the limits of even the extended time at which the essays were to be sent in. On the failure of this scheme prizes are offered for disease-proof potatoes, "disease-proof" being subsequently defined to mean immunity from disease in twenty different districts for three years. Were a disease-proof potato a probable thing, it might clearly be trusted to establish its own reputation. Lastly, the amateur world of prize essayists having proved fruitless, the cryptogamic botanists of this country—many of them men of European fame, who would doubtless have willingly responded to an appeal from the Council to co-operate in the matter—are passed over *en bloc*, and the matter is placed in the hands of a German scientific man—highly and worthily distinguished, doubtless—but who, I am convinced, would be far from approving the slight placed on our countrymen, one of whom has accomplished what will ever be a classical research in this very subject. I submit that when I applied the expressions "spasmodic," "ill-considered," and "wanting in scientific method" to these proceedings, I was not using inappropriate language.

W. T. THISELTON DYER

Sensitive Flames

PERMIT me to thank Prof. Herschel for his all too kind acknowledgment of the aid my former brief communication to NATURE may have been to him. In a paper on Sensitive Flames that is awaiting the needful leisure to complete, I have given a brief history of this subject—which, by the way, so far as regards the discovery of sensitive flames, Prof. Herschel has partly misapprehended, though there can be no doubt the valuable letters of Prof. Herschel will play an important part in the development of these phenomena. I am glad to find that, so far as Prof. Herschel has recorded his views, they corroborate the results of my own experiments (begun as long ago as 1867) in search of the cause of the sensitiveness of various fluid jets, and the application of sensitive flames to acoustic investigation and other practical ends. For reasons, into which I will not enter here, I was led to postpone this inquiry, and it is only comparatively lately that it has been resumed.

The keynote to the whole of the phenomena is, I believe, to be found in Savart's beautiful investigations on liquid jets. Any fluid body, gaseous as well as liquid, escaping from an orifice in a tranquil stream, consists of a continuous and a discontinuous region, and is subject to the play of opposing forces which excite pulsations in the jet, the number of which is directly proportional to the velocity of the issuing stream, and inversely as the diameter of the orifice. When a note is sounded approximately in unison with the vibration number of these pulsations, the jet of water, smoke, or flame is thrown into more vigorous vibration, and a strained condition of the jet is set up.

Hence it is easy to obtain a series of sensitive flames, issuing from orifices of decreasing size, capable of responding (within a certain range) to the successive notes of the gamut; the higher notes affecting, of course, those flames from the smaller orifices, and which also require to be under greater pressure of gas than the flames responding to the lower notes. The relative rate of vibration of these flames is at once clearly seen by viewing them together in a moving mirror. But I will not weary your readers by further entering upon a subject with which already they must be somewhat tired.

W. F. BARRETT

Royal College of Science, Dublin, Nov. 30

Fossils in "Trap"

I AM much obliged by your insertion of my letter on "Fossils in Trap." You are right in supposing that the trap I referred to was crystalline augitic trap. If it had been tufa I should not have written to you as I did, as I was well aware that fossils in tufa were of common occurrence. Shortly after I wrote I found that the *Favosites gothlandica* which shows the section is still imbedded in a portion of the slate, which is olive-coloured, and closely resembling the trap. This is so intimately connected with the trap that it is impossible to trace a *line* of connection.

Halifax, Nova Scotia, Nov. 14 D. HONEYMAN

[Dr. Honeyman's discovery would appear to resolve itself into the simple fact that his "trap-dyke" has involved in its mass fragments of the fossiliferous strata through which the molten rock has risen—a fact, we presume, with which every practical geologist who has worked amongst igneous rocks must be more or less familiar.—ED.]

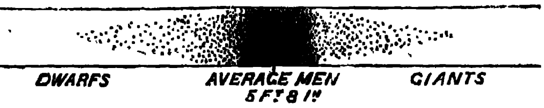
THE RELATION OF RACE TO SPECIES

IN a notice of Quetelet's works, published in NATURE, vol. v. p. 358, I raised the question whether this eminent statistician's method of defining a race or population might be applied to provide naturalists with a means of defining species. Since then, the consideration of Mr. Francis Galton's explanatory diagram, given at p. 28 of his work on "Hereditary Genius," has led me to attempt to carry this problem a stage further.

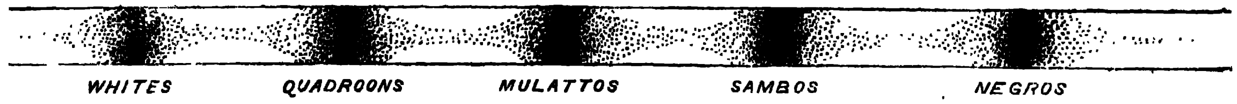
Instead of using, with Quetelet, a binomial curve to show the constitution of a race, with its central type and varieties, Mr. Galton sets before our minds the very individuals who compose the mass, each one being represented by a dot. His diagram, adapted in (*a*) of the present figure, stands for a population descended from a common ancestral stock, the individuals congregating most closely about the place of the central type or standard individual, and gradually decreasing in numbers as they become more different from that type or standard. In this graphic representation, the race can, of course, only be arranged in order as to some one quality. In the particular case for which Mr. Galton uses it, this quality is stature. The individuals of the mean or average height (say, 5 ft. 8 in.) are shown as most crowded, while the taller and shorter men become fewer and fewer as their stature becomes more unusual, till at last we come to one or two outlying giants and dwarfs, beyond whom no more individuals exist. Here, then, is set before us the distinctest idea of a race, both as to its type and as to its limits of variation on either side. I now proceed to apply the method of this diagram to a more complex state of things.

In nature we habitually find races blending into one another. Our own species shows this perfectly, when mixed breeds are considered. Let a population partly of Europeans and partly of negroes be placed on a West Indian island. These two races being classified according to colour, a few of the darkest Europeans would be seen to make some slight approach towards a few of the lightest negroes; but there would be no individual of either race who could be mistaken for one of the other. They would, therefore, at the outset be represented by two such groups of dots as (*a*), with a blank space between. But as soon as the first generation of mulattos come into existence the case will be altered. An intermediate race has arisen with its definite central type, and its variants now coming much closer to the whites on one side and to the blacks on the other. In the next generation there will be quadroons and sambos (cross between negro and mulatto, Spanish *zambo*). Now the fusion will be so complete, that of many individuals it will hardly be possible to say whether they are quadroon or mulatto, while in the same way others may be either mulatto or sambo, or either sambo or negro. One or two more generations would still further obliterate the distinction between adjoining varieties, but for convenience sake the figure (*b*), showing the blended races, is taken only in the second generation. In this way the whole human species, or any species of plants or animals, may be ideally classified into its various races, either in fact blending into one another, or capable of so blending by intercrossing. A species thus classified into its component races is shown either in (*b*) or the central part of (*c*).

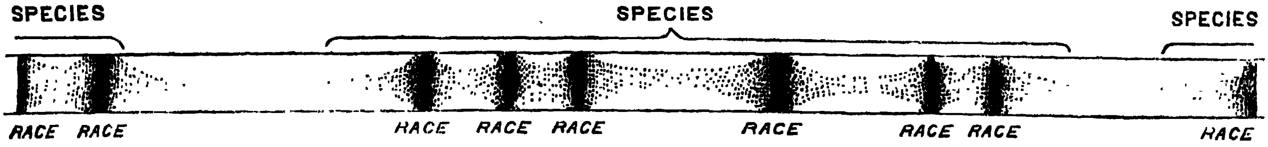
(*a*)



(*b*)



(*c*)



Let us now attend to the effect of variation, artificial or natural. Starting with a single race, this may in the course of time and circumstance develope within itself a number of varieties or races. Nor, if variation is promoted either under domestication or by various conditions of life acting for a long series of generations, is there any difficulty in conceiving two adjacent varieties to recede from one another and the intermediate individuals to die out, till a wide gap is left between the two races. At first this gap, though real, would be capable of being at any time bridged over by cross-breeding, and thus would only be a temporary break. But as variation went on, a critical period would at last be reached, when individuals from the two sides could no longer produce fertile offspring. Then a separation of one species into two would have taken place. This change is illustrated in (*c*), where the extreme forms of two adjacent species are seen to the right and left, still perceptibly near the extremes of the original species from which they have parted, but never to be joined to it again unless by a process of backward variation most unlikely to happen across any width of interval. This ideal representation was at first intended rather to show the actual distribution of animals in existing species than to involve a hypothesis as to how these species originated. But, after consulting Mr. T. R. Stebbing, I see the desirableness of making the diagram express both facts and hypothesis, leaving those who will to take them apart. The whole figure, as it stands, contains an ideal of evolution or development from a single race of animals at (*a*), into a species made up of several races at (*b*), and thence into any number of separate species at (*c*).

EDWARD B. TYLOR

TRANSIT OF VENUS

Colonel Tennant's Station at Roorkee, India.

THE full and very able account of the preparations for observing the Transit of Venus drawn up by Prof. Forbes and published in these columns do not include those which have been made by the Government of India under the authority of the Secretary of State in Council. When Prof. Forbes wrote, these were not sufficiently advanced to admit of description. Now that they are completed it is desirable that an account of them should be made public.

At an early period Col. J. F. Tennant, R.E., F.R.S., brought the subject before the Viceroy in India, and proposed the organisation of a station in the north-west, near Roorkee, well known as the seat of the great Civil Engineering College. The Viceroy heartily responded to the suggestion, and communicated his views to the Home Government.

Some time was unfortunately lost in official correspondence, and it was not until July 1873 that I received final authority to order the necessary instruments. With the sanction of the Secretary of State, I conferred with Mr. Warren De la Rue on the subject, and am indebted to that gentleman's zeal and experience for a great deal of valuable assistance.

The following is a list of instruments prepared by Mr. De la Rue and myself, and sanctioned by Government:—

1 Photoheliograph.
1 Equatoreal.
1 Altazimuth.
1 Transit Instrument.
1 Chronograph.
1 Standard Clock.
3 Journeyman Clocks.

I will briefly describe each of these.

Photoheliograph.—This is of the same identical size and construction as those supplied to the stations equipped under the auspices of the Astronomer Royal. It is well known that these have been constructed from the designs of Mr. De la Rue and under his close personal supervision. I therefore advised that that gentleman, as the first authority on the subject, should be requested to superintend the provision of this particular instrument, and that he should have *carte blanche* for the introduction of any improvements or additions suggested by his constantly enlarging experience. My recommendation was adopted, and I need hardly say that Mr. De la Rue, with his usual public spirit, at once gave his services to the Government and to science. This instrument, like its prototypes, was made by Mr. Dallmeyer. Janssen's apparatus, modified by Mr. De la Rue, for multiplying the photograms, has been supplied to this instrument.

Equatoreal.—This has an object-glass of six inches clear aperture. It was made by Messrs. Cooke and Sons, of York, and is generally of the form which those artists have made familiar to the astronomical world. It is a universal instrument, being capable of adjustment for any latitude to 67° 39′, and in either hemisphere, for which latter purpose it has reversible driving-gear and two hour-circles readily interchangeable. Besides a striding level for making the declination axis horizontal, two delicate levels are suspended from the centre of the telescope. A graduated circle and delicate level is also attached to the telescope near its eye end. This, in conjunction with a micrometer in the eye-piece, will qualify the instrument for determining latitude by the differential observation of two stars of nearly equal zenith distances, north and south. The instrument has two micrometers—a parallel wire by the makers, and a double image micrometer by Messrs. Troughton and Simms, precisely similar to those supplied for other stations under the auspices of the Astronomer Royal. The parallel wire micrometer has a contrivance intended to enable the observer to record the readings of the divided head without withdrawing his eye from the eye-piece, as suggested by Mr. Christie, of the Royal Observatory. The form actually adopted by the makers differs both from that employed by Mr. Christie and that prescribed by me. I am unable to express any opinion on its efficiency, as it arrived from the makers after the instrument had been despatched to India, and I could not try it.

The instrument is well supplied with eye-pieces and all necessary adjuncts, and the arrangements for bringing down the various adjusting and slow-motion screws to the observer's hand when observing are very complete, and many of them, I believe, as novel as they are ingenious and effective.

I had but one brief opportunity of trying the object-glass, but that sufficed to satisfy me that it is of a high order of excellence.

Altazimuth.—The place of this is supplied by the great theodolite constructed, from my designs, by Messrs. Troughton and Simms, for the Great Trigonometrical Survey of India, and now about to be employed for the first time. The main features of this instrument were described by me in a paper read before the Royal Society and published in its Proceedings, No. 135, of 1872. I may briefly state here that the horizontal circle is three feet in diameter, read by five equidistant micrometers, the circle being fixed and the micrometers revolving; that the vertical circle is two feet in diameter, read by either two micrometers fixed, or by four capable of being shifted so as to change the divisions and thus reduce errors of graduation; and that the telescope has an aperture of 3·25 in., and a focal length of 36 in., to which can be attached either of two parallel wire micrometers—one for measuring in the vertical, the other in the horizontal plane, according to the class of observation, the wires having both a dark and a bright field illumination.

This is no doubt the most elaborate and most powerful instrument of its class in existence.

Transit Instrument.—This is of a peculiar and, I believe, in many respects novel form. It is from the designs of Signor Magnaghi, of Genoa, modified by the makers, Messrs. Cooke, of York, and myself. Signor Magnaghi's object was to produce an instrument capable of determining latitude, as well as of performing the usual functions of a transit instrument, those of determining time and longitude. The telescope has an aperture of 3 in. and a focal length of 34⅞ in. with a transit axis of the usual form 18¼ in. in length between the pivot shoulders. The stand is of cast iron, and consists of first a massive circular base plate 24 in. in diameter, supported, according to the system introduced by me, by three shakeless foot-screws, upon a single masonry pillar. On the base plate revolves horizontally a second similar plate with the two pillars cast hollow in one piece with it. This upper revolving plate moves stiffly, and is provided with slow-motion screws and four powerful clamping bolts. When it is bolted to the lower base plate, the two may be considered practically to be one mass. The horizontal motion thus provided is used, first, for effecting the ordinary azimuthal adjustment of the instrument to the plane of the meridian; and secondly, the direction of the meridian having been found, for placing the telescope with great facility in the plane of the prime vertical for the determination of latitude by that method.

An apparatus is also supplied for lifting the telescope and reversing its pivots on their bearings, the transit axis level remaining suspended from the pivots during the process. This arrangement also admits of the instrument being used to determine latitude by the differential observation of two stars of nearly equal zenith distances, north and south; for which purpose the telescope is provided with a parallel wire micrometer and a delicate level.

Chronograph.—Col. Tennant attached, justly I think, great importance to means being provided for the electric record of the time observations which form so essential a portion of the undertaking. He wished to have a chronograph which should be capable of recording at the same time, and without confusion, observations made with four different instruments, viz., the Photoheliograph, Equatoreal, Altazimuth, and Transit Instrument, and he indicated the apparatus described by Lord Lindsay in Monthly Notices, R.A.S. I therefore examined Lord Lindsay's chronograph, then under construction by Messrs. Cooke, of York, but, though no doubt suitable for a fixed observatory, such as his lordship is establishing, I thought it too large and ponderous for the present service. I accordingly arranged with Messrs. Cooke a much lighter and, I may add, a less costly plan. By substituting continuous bands of paper, similar to those used in telegraphic instruments, for sheets of paper carried by the large barrels employed by Lord Lindsay, great increase of compactness and lightness were secured. Four such bands are worked by one central clock movement, each or all being readily thrown out of gear at will. The marking is effected by steel prickers driven by electro-magnets, on the same principle as in the chronograph of the Royal Observatory, Greenwich, though the mechanical details were different. These prickers can also be thrown out of action by a convenient arrangement of resistance coils. The length of a single second of time can, by changing two wheels, be made either one, three-quarters, or half an inch. I had prescribed that the central clock work should be regulated either by the late Léon Foucault's lever governor or by Mr. Siemens' centrifugal fluid governor, but the maker, without consulting me, applied a Watts ball governor with friction-brake, such as is employed for the driving-clock of equatoreals. I did not expect that this comparatively primitive contrivance would secure a sufficiently uniform velocity. But on trial by Capt. Campbell, R.E., and myself, it was found to answer its purpose so well that I am inclined to think a great deal of needless refinement and expense has been wasted on elaborate governors for chronographs.

Standard Clock.—This is by Messrs. Cooke, of York, and has nothing peculiar in its construction. It has a Graham's dead beat escapement, and a mercurial (metal jar) compensated pendulum, with the contact apparatus necessary for connecting it electrically with the chronograph.

Three Journeyman Clocks.—These were intended by me to be connected electrically with the Standard Clock, and thus show identical time for each of the principal instruments from which the latter might not be visible. I was not satisfied with the mode of driving adopted by the makers, and should have had them altered if time had admitted. Col. Tennant is also dissatisfied with them, but I hope that, with careful adjustment and attention to the batteries and contacts, they may be found effective during the short period of the phenomenon.

It fortunately happened that whilst these instruments were undergoing examination by me, Capt. W. A. Campbell, R.E., of the G. T. Survey of India, who is to assist Col. Tennant with the Venus observations, was in England. The Government, on my application, appointed Capt. Campbell to assist me in testing the instruments, and thus the two objects were gained of securing his valuable experience and skill, and of familiarising him with the instruments which he would have to use.

I have heard from Col. Tennant of the safe arrival at Roorkee of the photoheliograph, altazimuth, chromograph, and clocks, and of the expected arrival in a few days of the Equatoreal, his last letter to me to that effect being dated 9th Oct., 1874. There would only remain the Transit Instrument, which was much delayed in construction. It was despatched hence on Sept. 18, 1874, and is no doubt now in Col. Tennant's hands.

In the foregoing statement I have confined myself to those arrangements which I have been personally concerned in making. But other places in India will be provided with equipments more or less complete for observing the Transit of Venus—amongst others I may mention Peshawur, Bombay, and probably more than one station in the southern part of the peninsula under the care of Mr. Pogson, Government Astronomer at Madras. The Government of India has thus not been unmindful of the just claims of astronomical science.

A. STRANGE, Lieut.-Colonel,
Inspector of Scientific Instruments
to the Government of India
Lambeth Observatory, Nov. 1874

PRACTICAL SCIENCE AT CAMBRIDGE

DR. MICHAEL FOSTER, in concluding his course of Practical Physiology this term, remarked on the diligence and industry of his class under many difficulties. At the beginning of the term he asked their indulgence for the imperfect accommodation he was able to offer them. Thirty students had been entered, and the space available was about sufficient, properly, for ten. Three students had to be placed at each table, instead of one. Several other gentlemen joined the class subsequently, making the class number about thirty-five. Two ladies also attended the lectures, and were provided with a separate place of study. Dr. Foster at his last lecture said that in the previous year the want of accommodation had been so keenly felt by himself and class that he was inclined to discontinue his course. He had, however, conducted it through another term, with a larger number of students; and, as the result, although he expressed pleasure at the work accomplished by his class, he was more than ever inclined to give it up. The present course would, however, be completed next term; but he was not able to promise its repetition in the succeeding winter. Want of accommodation militated so greatly against the quality of the work done, and so limited the kind of work that could be attempted, that the benefit seemed almost to be outweighed by the limitations and disheartening accessories.

The publication of these remarks may serve to draw attention to the general condition of practical science in Cambridge. Chemistry and geology are perhaps the subjects for the practical study of which we now have the most reasonable facilities. The Chemical Laboratory has been recently enlarged and improved, and in addition to the ordinary practical courses Prof. Liveing has this term given lectures with practical illustrations in spectroscopic analysis. The lectures have been given during four successive hours of the afternoon, to four sets of students, the number of students in each class being limited to four or five; so that thoroughly efficient work could be done. The facilities for study at the Geological Museum have been improved by Prof. Hughes. A typical collection of fossils has been selected and arranged by Mr. Keeping, and provided with catalogues. A typical series of minerals has been arranged and catalogued by Mr. W. E. Koch, B.A., of St. John's College, derived from the ample stores accumulated by the late Prof. Sedgwick. Several large series of rock specimens have been more conveniently arranged for inspection, including those catalogued by the Rev. T. G. Bonney. In addition, advanced students have free access to the many valuable special collections in the Woodwardian Museum. The Geological Library in the museum has been improved and catalogued; a valuable section-cutter and an excellent microscope have been purchased, and in other ways the means for the practical study of geology, so far as it can be carried on in a museum, have been greatly improved.

In Experimental Physics the best conditions for practical study have been secured in the building of the Cavendish Laboratory, in its being furnished with some of the most perfect and valuable physical apparatus in existence, and in the appointment of Prof. Clerk Maxwell and his able demonstrator, Mr. Garnett. No doubt at the earliest possible moment a practical elementary course will be organised, to include those observations which every student of natural science should become familiar with. Sufficient time has not yet elapsed since the completion of the laboratory for the establishment of such an elementary class; but when it is established a great boon will be conferred on Natural Science students, who, in the study of biology and geology, labour under many difficulties caused by a want of sufficient practical acquaintance with physics. It would be very desirable, also, if some elementary non-mathematical lectures on physics could be given for the benefit of Natural Science students; such lectures might be given by the Demonstrator, so as not to interfere unduly with Prof. Maxwell's researches and advanced mathematical lectures. It is true that Mr. Trotter gives valuable lectures on physics at Trinity College, but these are restricted to members of those colleges which are associated with Trinity for Natural Science studies.

The great hindrance to the success of the Cavendish Laboratory at present is the system fostered by the Mathematical Tripos. The men who would most naturally be the practical workers in the laboratory are compelled to refrain from practical work if they would gain the best possible place in the Tripos list. Very few have courage so far to peril their place or to resign their hopes as to spend any valuable portion of their time on practical work; for, while they might be acquiring sound physical conceptions and going through long laborious details, others are assiduously cramming book-work, wearing out their energy in attacking those problems which are here set before the student as affording the best mental training, and in learning those short cuts and dodges which conduce to obtaining marks in an examination. For a man to do practical work in physics at Cambridge implies considerable exercise of courage and self-sacrifice.

Students of the foregoing subjects, however, have better facilities for study than students of Biology. In Practical Physiology and Histology almost everything is required. A large room, properly lighted and fitted, is needed for elementary courses; and, considering the numbers already attracted to Dr. Foster's summer and winter classes, in spite of difficulties and defects, it would seem desirable to provide accommodation for at least a hundred students. Rooms should also be provided, specially adapted for advanced work in Histology, for researches in Physiology, for preparation of experiments and of materials for the classes, and, in addition, a good lecture-room.

In Comparative Anatomy and Zoology the museum has been much improved in the last few years, but its growth is greatly restricted by want of funds. The accommodation for practical dissection of animals consists only of the superintendent's private room, which, at the cost of great inconvenience, has been generously thrown open to students.

Finally, as regards Botany, while there are a good garden and a carefully kept herbarium for systematic study, there is no class of any kind for practical study of Vegetable Histology and Physiology. And yet, recently, the standard for obtaining an ordinary degree in Botany has been considerably raised, and students are expected to show knowledge of the forms, sizes, and development of cells of every kind. The demand for an acquaintance with Vegetable Histology, which, to be real, must be acquired by assiduous and carefully directed microscopical study, while no instruction in such work is given, puts a premium on cramming of the most unfruitful kind, and reduces natural science studies to a lower level than those mathematical and classical studies whose exclusive pursuit scientific men desire to see abandoned. It would be better to examine only in those portions of morphology and classification which can be learnt in a botanic garden, than to set elaborate questions in Histology and Physiology which necessitate elaborate cramming on the part of the student. G. T. BETTANY

Cambridge, Dec. 10

M. BECQUEREL ON SOLAR PHYSICS

THE Paris Academy of Sciences having appointed a Commission to consider the founding of an Observatory for Physical Astronomy in the vicinity of Paris, M. Becquerel the elder, a member of the Commission, has expressed his opinion on the subject in a report of which the following is a translation:—

To study the physical constitution of the sun and stars, Astronomy employs in general telescopes and the spectroscope; this last instrument shows us that the heavenly bodies are composed of the same elements that are found in the earth; whence it may be concluded that the forces governing matter are of universal existence. This question I have considered in a work now going through the press, and which will appear before the end of the year; its title is "On the Physico-chemical Forces and their Intervention in the Production of the Phenomena of Organic and Inorganic Nature." All questions relating to these subjects are there treated, not theoretically, but by the experimental method.

I have endeavoured to show that to arrive at a knowledge of the sun's constitution it is necessary to call to our aid the geological constitution of the globe and volcanic phenomena from the earliest times down to the present epoch.

The following are the reasons which have led me thus to deal with the subject:—

The identity of formation of the sun and earth and of all the planets which gravitate around our principal star being admitted, the conclusion may be drawn that his present physical condition is the same as that of our planet during the first periods of its formation, when the crust did not exist or had but little thickness. The cooling of the earth has been considerably more rapid than that of the sun by the effects of celestial radiation, the volume of the sun being 1,326,480 times that of the earth. It is thus permitted to compare the chemical and physical effects occurring in the sun at present with those which were produced in the earth at its origin, from which conclusions may be drawn as to the actual constitution of this star.

The collection of vapours which constituted the earth, submitted to a gradual cooling, passed successively from the gaseous to the liquid state, after which its surface became covered by a solid crust, of which the thickness increased with time. There were then produced a mass of chemical and physical phenomena.

We may distinguish three principal calorific epochs during the formation of our planet.

The first is that in which all the elements were in a gaseous state in consequence of a temperature excessively elevated; all the constituents were then dissociated.

The second is that in which, the temperature being sufficiently lowered, affinities commenced to exercise their action; the compounds formed passed successively from the gaseous to the liquid and solid states. During all the chemical reactions which occurred there would be produced an enormous disengagement of electricity arising from the energy of these reactions, and, as a consequence, a recomposition of the two electricities which would rend with vivid gleams the atmosphere already formed. Thunder would burst forth from all parts.

The third epoch is that in which the temperature, being sufficiently lowered and below 100°, the quantity of water formed would increase so much the more as the temperature was less elevated. This primordial water contained, probably, carbonic, sulphuric, and other acids which would saturate bases; it is to the reactions produced that must be attributed the formation of the great masses of limestone found in various parts of the earth's crust.

I have been led also in my work to treat of the calorific state of the earth in the first phases of its formation, as also of the volcanic phenomena of the same epochs.

As a consequence of the subjects discussed, I have been led to show that atmospheric electricity had a solar origin, and is the cause of the aurora and probably of the luminous phenomena which are produced beyond our atmosphere. I here limit myself to the indication of the consequences to which the study of the forces of nature has led me.

From what precedes it will be seen that the study of the constitution of the sun requires the conjunction, not only of astronomy, but of observers having general knowledge in Physics, Geology, and Chemistry, and possessing a thoroughly practical knowledge of the spectroscope.

R. M.

REAPPEARANCE OF ENCKE'S COMET

IT is quite possible that before the close of the next period of absence of moonlight in the early evening hours, the comet of Encke may be again detected with the large telescopes now to be found in our observatories. The mean motion determined by Glasenapp for the last perihelion passage at the end of December 1871 would bring the comet to the same point of its orbit about 1875, April 11.5, which was very nearly the date of passage through perihelion in 1842. When it was last in aphelion, in the middle of August 1873, I find its distance from the planet Jupiter would be 10·02, and that from Saturn 7·3, so that the perturbations during the present revolution are likely to be small; the comet still approaches near the orbit of Mercury in heliocentric longitude 123·7° and latitude 6·8° N., but it has not encountered that planet since November 1848. Assuming, then, that the least distance from the sun will be attained at midnight on the 11th of April next, we have the following positions of the comet during the period I have named:—

AT 12H. GREENWICH TIME

1874–75.		R.A.	N.P.D.	Distance from Earth.	Distance from Sun.
		h. m. s.	° ′		
Dec. 22	...	22 50 31	88 19·9	1·945	1·919
„ 26	...	22 53 12	88 9·9	1·958	1·874
„ 30	...	22 56 18	87 57·2	1·968	1·828
Jan. 3	...	22 59 47	87 41·6	1·976	1·781
„ 7	...	23 3 38	87 23·2	1·981	1·733

An acceleration or retardation of four days in the time of perihelion passage will not change the geocentric place more than fifteen minutes of arc, so that if the comet be within reach it may be easily found.

It will be interesting to learn what account some of the large reflecting telescopes with which many amateurs in this country have provided themselves, can give of the comet at this return.

The computation of the perturbations and preparation of an accurate ephemeris for 1875 is understood to be in the hands of Dr. von Asten, of Pulkova; but I am not aware that the results have yet been given to astronomers.

J. R. HIND

Mr. Bishop's Observatory, Twickenham, Dec. 14

NOTES

SINCE our last week's note, we understand that the whaling steamer *Bloodhound*, of Greenock, has been purchased as the chief vessel of the new Arctic Expedition. Other whalers have been examined by Sir Leopold M'Clintock, but none have been deemed suitable. The *Bloodhound* is a screw steamer, whose engines are nominally 96 horse-power; she is barque-rigged, two years old, strong, sound, and well appointed, and handy either under steam or canvas. It is announced that the vessel chosen to be the consort of the steam-whaler *Bloodhound* in the forthcoming expedition is Her Majesty's ship *Alert*. She is a five-gun steam-sloop of 751 tons old measurement, and 100 horse-power nominal. The *Alert* has been docked at Portsmouth and will undergo a thorough survey. Active preparations for the equipment of the ships will soon commence, but the start will not be made until the latter part of June of next year, as it is considered merely waste of labour and time to push across the north water until the ice has had time to melt and drift out from Smith's Sound. A request has been made by the Foreign Office that the Danish Government will permit their agents at Disco, Proven, and Upernavik to collect hunters, dogs, and dog-drivers for the Arctic Expedition. Capt. Nares is expected to arrive in this country about the end of January, 1875. The Committee for making arrangements with respect to the Expedition sat on Tuesday and Wednesday at the Admiralty for the purpose of deciding on the provisions and clothing to be supplied to the members of the expedition. They have been occupied hitherto with details as to the route.

Apropos of the possible biological results of the Arctic Expedition, we may recall to recollection a few additional details to those given last week of what was accomplished by the *Polaris*. The northern limit actually reached was 82° 16′. Yet at this extreme latitude fifteen species of plants were collected, five of which were grasses. Twenty-six musk oxen were shot in lat. 81° 38′. Dr. Bessels also made a fair collection of insects, principally flies and beetles, two or three butterflies and mosquitos; and birds of seventeen different kinds were shot in 82°, including two Sabine gulls and an Iceland snipe.

DURING the whole of the past week the members of the French Academy of Sciences have had frequent meetings to receive the telegrams from the several French Transit stations. The first, from Janssen, relieved them of a great anxiety, and was published instantly. The most extraordinary measures have been taken to secure the safe transmission of the results of the observations at French stations. The chief of each station is ordered to make four copies of his observations. One is to be left under a cairn, or a tree (if any in the country), or in an excavation, the site to be described in a letter to the Institute; the second is to be handed over to the captain of the first French ship that is met, with instructions to bring it himself to the Institute; the third is to be delivered to the nearest French consul, agent, or ambassador; the fourth is to be kept by the chief of the station himself.

MM. FIZEAU and Cornu, authorised by M. Leverrier, have been making an experiment of the highest importance at the Paris Observatory, the results of which were to be given at Monday's sitting of the Academy. The two *savants* have been measuring the velocity of transmission of light, by experiments carried on between the Observatory and Montlhéry. The light sent to Montlhéry is reflected and returns to the Observatory, the distance there and back being 22,000 yards. The experiment has never hitherto been made on so grand a scale, nor with such precautions; ten powerful instruments were used.

HER MAJESTY'S ship *Basilisk*, which has just returned to England after a commission of nearly four years, has (the *Times* states) surveyed about 1,200 miles of coast line, added at least twelve first-class harbours, several navigable rivers, and more than one hundred islands, large and small, to the chart; and, lastly, has been able to announce the existence of a new and shorter route between Australia and China. Till these *Basilisk* discoveries were made, a large archipelago of islands (some as large as the Isle of Wight, and densely populated), a rich fertile country, intersected by navigable rivers, and inhabited by a semi-civilised Malay race, remained unknown to us. After the news of this ship's first discoveries reached England, Lieut. Dawson, R.N. (Admiralty Surveyor), was sent out to join her, and she was ordered to complete and follow them up. This has been done with perfect success, and the whole of the previously unknown shores of Eastern New Guinea have been carefully surveyed, and the route above referred to opened up. The principal part of this work of discovery and surveying has been performed by the captain and officers in small open boats, detached from the ship in some instances for many weeks, and among savages who had never before seen a white face. It is stated that two lofty mountains, about 11,000 feet high, facing each other on the north-east coast of New Guinea, have been named "Mount Gladstone" and "Mount Disraeli." This intelligence will have an interest of rather a tantalising kind for naturalists. There is hardly any part of the world more promising to students of the geographical distribution of living forms than that which the *Basilisk* has surveyed. Collections, more especially of the plants, might doubtless often have been made, and would have been of the highest possible value. It is much to be wished that with the existence of such opportunities as these some one might be found to put in a word in aid of purely scientific claims. Doubtless it is pleasant to think that the two rival mountains will be a perpetual memory of frowns frowned elsewhere, but how much more pleasant to know something of the things that grow and live upon them.

THE *Irish Times* states that one of the objects of Sir Stafford Northcote's visit to Ireland is to "examine the sites proposed for the establishment in Dublin of an extensive National Museum of Science and Art, analogous in principle, although not in extent, to that at Kensington."

AFTER the Franco-Prussian war of 1870-71, it is well known that in many districts in France a new vegetation sprang up, evidently the result of the invasion. It was believed that this vegetation would become acclimatised. It is not so, however, *L'Institut* informs us ; at least very few of the species introduced in this way appear likely to continue to flourish on French soil. In the departments of Loiret and Loir-et-Cher, of 163 German species, the half at least have already disappeared, and the surviving species diminish in vigour each year. Scarcely five or six species would appear to manifest any tendency to become acclimatised ; these are, according to M. Nouel, *Alyssum incanum*, *Trifolium resupinatum*, *Rapistrum rugosum*, *Melilotus sulcata*, and *Vulpia ligustica*. On the plateau of Bellevue, where in 1871 many strange species were seen, M. Bureau has been able to find only one—*Trifolium resupinatum*. M. Gaudefroy also, who in 1871 and 1872 found many adventitious plants, has been able to collect only two this year—*Ranunculus macrophyllus* and *Linum angustifolium*.

THE Transactions and Proceedings of the New Zealand Institute always contain a collection of papers of high scientific value, and vol. vi. issued last June is no exception to this rule. It is a bulky volume of some 454 pages, added to which is an appendix of 104 pages more. It may not be known to many of our readers that the New Zealand Institute is composed of the following incorporated societies, each of which includes amongst its office-bearers and members one or more names eminent in science in the colony and well known in this country. The individual societies are, the Wellington Philosophical Society, Auckland Institute, Philosophical Institute of Canterbury, Otago Institute, and the Nelson Association for the Promotion of Science and Industry. On the council of these various societies occur such names as Dr. Hector, F.R.S., Dr. Haast, F.R.S., Mr. W. T. L. Travers, F.L.S., Mr. T. Kirk, F.L.S., &c. Each one of the societies numbers amongst its members the scientific men of its neighbourhood, and amongst the honorary members of the incorporated Institute are such names as Charles Darwin, Prof. Huxley, Dr. Hooker, Sir Charles Lyell, Prof. Owen, Prof. W. H. Flower, &c. These facts are sufficient to show that New Zealand is particularly fortunate in having amongst its residents men eminent in various branches of science. No colony has shown more aptitude for scientific work than New Zealand, and perhaps no other colony can boast of a society approaching so near to our Royal Society, both as regards the value of the papers contributed and the range of scientific investigation. Zoology, Botany, Chemistry, and Geology are all represented by numerous papers in each section. In the first, Dr. Haast contributes an illustrated article "On *Harpagornis*, an extinct genus of gigantic raptorial birds of New Zealand ;" while Dr. J. E. Gray, who is an hon. member of the Institute, supplies a "List of Seals, Whales, and Dolphins of New Zealand," and Capt. F. W. Hutton some "Notes on some New Zealand Fishes." In Botany we find a "List of the Algæ of the Chatham Islands, collected by H. H. Travers, and examined by Prof. John Agardh, of Lund"; "Notes on the Flora of the Province of Wellington, with a list of plants collected therein," by John Buchanan ; and by Mr. W. T. L. Travers a few notes "On the spread of *Cassine leptophylla*." In Chemistry, Mr. W. Skey talks about the Mineral Oils of New Zealand ; and in Geology are papers "On the Formation of Mountains," by Capt. Hutton ; "On the Extinct Glaciers of the Middle Island of New Zealand," by W. T. L. Travers ; "On the Fossil Reptilia of New Zealand," by Dr. Hector ; besides other interesting papers.

THE Cambridge Natural Science Club has held eight meetings this term on Saturday evenings, and some good papers have been read by the members at the meetings in their rooms, usually followed by a discussion. The attendance has mostly been under the average of other terms, on account of some of the members being candidates in the Natural Science Tripos now being held. The following are some of this term's papers :—"The Reniportal Circulation," by Mr. P. H. Carpenter (Trin. Coll.) ; "Vegetation as affecting Climate," by Mr. J. M. F. H. Stone (St. Peter's Coll.); "Tides," by Mr. Arthur Buxton, B.A. (Trin. Coll.) ; "Comparisons of Nervous Systems of Vertebrata and Invertebrata," by Mr. T. W. Bridge (Trin. Coll.) ; "The Influence of Molecular Structure upon some Organic Bodies," by Mr. E. B. Sargant (Trin. Coll.) ; "The Theory of the Identity of Matter," by Mr. P. R. Ogle (St. Peter's Coll.) ; "The Development of Blood," by Mr. S. H. Vines (Christ's Coll.)

IT is gratifying to see a growing tendency in the not professedly scientific press to endeavour to account for the causes of phenomena which it is called upon to notice ; thus, consciously or unconsciously, treating occurrences in a scientific spirit. For example, *The Country*, in speaking of the migration of birds, states that woodcocks have been unusually scarce in Cornwall for the past two or three years, nor is the present season an exception to the rule, for, notwithstanding favourable winds and moonlight nights, they continue *raræ aves* in the county. In attempting to account for this, *The Country* very pertinently suggests that improved agriculture has more or less destroyed the feeding grounds, though, as the same may be said of other parts of the kingdom where such game is not scarce, this cannot be the only cause.

A TELEGRAM to Cairo, dated the 8th inst., from the Governor-General of the Soudan, announces that the entire kingdom of Darfour has accepted annexation to Egypt.

THE American Society of Paris proposes to hold an "International Congress of Americanists" at Nancy, near Paris, on the 22nd of July, 1875, the object being to bring together those who are interested in the history of America prior to its discovery by Columbus, and in the interpretation of the monuments and of the ethnology of the native races of the New World. An exhibition of American Archæology is to be held at the same time. Any American can be enrolled as a member of the Congress by forwarding the sum of twelve francs to Mr. Lucien Adam, secretary of the American Society of Arts, Rue Bonaparte, in Paris.

A SERIES of experiments has lately been made by the Russian Government with reference to the use of electricity for the head-light of locomotives, a battery of forty-eight elements making everything distinct on the railway track to a distance of over 1,300 ft.

A CURIOUS phenomenon frequently met with in the Indian Ocean, the real cause of which has not yet been ascertained, is the existence off Malabar, and in certain spots along the Coromandel coast, of vast mud banks, and of tracts of mud suspended in the sea, wherein many kinds of fish find abundance of food, immunity from much disturbance in the surrounding element, and a locality in which to breed. The exact cause of the existence of these large tracts of sea wherein mud remains in solution is still a mystery, but at any rate the ocean is so smooth that, even during the height of the south-west monsoon, vessels can run for shelter into their midst, and once there are as safe as when inside a breakwater. If the surface is so still, of course so is the water below, and such spots seem to be well suited to the siluroid fishes. These curious patches of sea which appear in a continually perturbed state, and the sea-bottom in the locality, would probably well repay careful scientific observation.

THE manufacture of isinglass, generally supposed to be confined to Russia and North America, or other countries where the sturgeon is found in abundance, is carried on to a considerable extent in India, principally from the air-vessels of several varieties of acanthopterygian fishes, and particularly, different kinds of perch, as well as from other fish. There is room for a great extension of the trade, as isinglass, the purest known form of animal jelly, has, in a measure, had its consumption checked by its high price, and substitutes are employed, such as gelatine, of which it is itself the purest form.

AT the last meeting of the British Association a committee was appointed to investigate the circulation of the underground water in the New Red Sandstone and Permian Formations of England, and the quantity and character of the water supplied to the various towns and districts from these formations. Prof. Hull, M.A., F.R.S., director of the Geological Survey of Ireland, is chairman, and Mr. C. E. de Rance, F.G.S., Scientific Club, 7, Saville Row, London, W., secretary. The following queries have been circulated by the committee for the purpose of eliciting information in connection with the important subject:—1. *Position* of well, or wells, with which you are acquainted. 2. Approximate *height* of the same above the mean sea level. 3. *Depth* from surface to bottom of shaft of well, with diameter. *Depth* from surface to bottom of bore-hole, with diameter. 4. Height at which water stands *before* and *after* pumping. Number of hours elapsing before ordinary level is restored, after pumping. 5. *Quantity* capable of being pumped in gallons per day. 6. Does the *water level* vary at different seasons of the year, and how? Has it diminished during the last ten years? 7. Is the ordinary *water level* ever affected by local rains, and if so, in how short a time? And how does it stand in regard to the level of the water in the neighbouring streams, or sea? 8. *Analysis* of the water, if any? Does the water possess any marked *peculiarity?* 9. Nature of the rock passed through, including cover of drift, with *thicknesses*. 10. Does the cover of drift over the rock contain *surface springs*. 11. If so, are they entirely kept *out* of the well? 12. Are any large *faults* known to exist close to the well? 13. Were any *salt springs* or brine wells passed through in making the well? 14. Are there any *salt springs* in the neighbourhood? 15. Have any wells or borings been discontinued in your neighbourhood, in consequence of the water being more or less *brackish?* If so, if possible, please give section in reply to query No. 9.

WE have received, among the results of the geographical and geological explorations of the Western (U.S.) States, the annotated list of the birds of Utah, by Mr. H. W. Henshaw, containing the names of 214 species, of which 160 were either taken or noted in the expedition. The author thinks that if collections were, as they have not yet been, made during the spring months, several extra species would have to be added to the collection.

COAL is beginning to attract attention in New South Wales, in some parts of which the mineral is being found in abundance, and the pre-eminence which gold and copper have maintained will be assailed by the increasing importance of the newly worked product. A seam, seven feet thick, has been opened at Broughton Creek, near the Shoalhaven River, and not far from the Moss Vale Railway Station; so that every circumstance of locality is in favour of its profitable working.

THE *American Chemist* for August and September, which we have just received, contains a full account of the proceedings at the Priestley Centenary in Northumberland, Pa., on July 31 last. There was then a large and enthusiastic gathering of men of science and others, and several valuable addresses were given. The principal one in the numbers before us is by Prof. B. Silliman, being a long, minutely detailed, and carefully compiled paper on "American Contributions to Chemistry."

WE are gratified to see that the *Geographical Magazine* has been so successful that the price is to be reduced to one shilling.

THE additions to the Zoological Society's Gardens during the past week include a Chamois (*Rupicapra tragus*) from the Pyrenees, presented by Mr. A. Wilson; a White-fronted Capuchin (*Cebus albifrons*) from South America, presented by Mrs. Carpenter; a common Boa (*Boa constrictor*) from South America, presented by Capt. E. C. Kemp; two Barred-tailed Pheasants (*Phasianus reevesii*) from North China, received in exchange.

ON THE STRUCTURE OF STIGMARIA *

AT a meeting of the Manchester Literary and Philosophical Society, held on October 20, Mr. Binney called in question some conclusions at which I had arrived and had published in Part II. of my memoirs on the Structure of the Coal Plants, respecting the organisation of Stigmaria. Mr. Binney further published an abstract of his remarks in Part II. of vol. xiv. of the Society's Proceedings. Believing that Mr. Binney's observations, if allowed to pass unnoticed, may mislead some palæontologists unacquainted with Stigmaria, I feel called upon to reply to them through the same channel as that which he has employed for their promulgation. The general features of the plant known for half a century as *Stigmaria ficoides* have been so well described by Lindley and Hutton, Dr. Hooker, Mr. Binney, and Brongniart, that no one familiar with those descriptions can fail to recognise it without difficulty. That plant consisted of a central medulla, surrounded by a cylinder of scalariform vessels arranged in radiating wedges, very distinctly separated by two kinds of medullary rays (primary and secondary), the whole being enclosed in a thick bark, from the surface of which spring numerous large cylindrical rootlets. The vascular cylinder gives off numerous large vascular bundles of scalariform vessels, which proceed outwards, through the conspicuous primary medullary rays, to reach the rootlets.

The dispute between Mr. Binney and myself resolves itself chiefly into three points: (1), the structure of the medulla of Stigmaria; (2), the source whence the vascular bundles supplying them are derived; and (3), the nature of some vascular bundles which both Mr. Binney and M. Goeppert have figured as existing within the medulla, and one of which is prolonged radially in M. Goeppert's example through a medullary ray. Mr. Binney and M. Goeppert believe that the cellular medulla of Stigmaria contained bundles of very large scalariform vessels, and that those bundles proceeded outwards to supply the rootlets. On the other hand, in my second memoir, referred to by Mr. Binney, I not only expressed my conviction, but demonstrated the absolute certainty, that such was not their origin. I adhere to the same opinion as I previously expressed, and have the specimens on the table which prove its correctness. The fact that these bundles were derived not from the medulla, but from the vascular wedges of the woody cylinder, was illustrated by the figures 43, 44, and 47 of the memoir referred to, figures which accurately represent, not conditions occasionally met with, but those which characterise every specimen of the true *Stigmaria ficoides*. In the memoir I further affirm that immediately within the woody cylinder there exists a delicate cellular tissue, and state that one of my specimens makes it perfectly clear that the entire medulla consisted of similar cells, unmixed with any vascular bundles whatever such as were represented in M. Goeppert's and Mr. Binney's figures, and the accuracy of which is, was, and it appears still is, endorsed by Mr. Binney. After thus endorsing what I believe to be a grave mistake, Mr. Binney proceeds to justify his doing so by appealing to a specimen which I have not seen, but which Mr. Binney's own description convinces me is a plant altogether different alike from the Stigmaria of authors, and from M.

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* A paper read before the Manchester Philosophical Society, by Prof. W. C. Williamson, F.R.S., Nov. 17.

Goeppert's and Mr. Binney's own figures. Mr. Binney's describes his new specimen as having a radiating woody cylinder, immediately within which is a second series of large vessels not arranged in radiating wedges, and which Mr. Binney says is "something like a medullary sheath, enclosing a medulla composed of very small and short barred tubes or utricles, in which are mingled large vascular tubes or utricles." Though this use of vague terms renders the sense obscure, I presume that Mr. Binney simply means that in the medulla of his plant a *vascular* cylinder encloses a *cellular* medulla, or, in other words, that his specimen has a Diploxyloid axis. That Mr. Binney possesses a specimen having the above structure, and giving off rootlets from its periphery, I have no reason for doubting, since in the memoirs already quoted I have described a similar structure under the name of *Diploxylon stigmarioideum*, and respecting which I make the following observations :—"It is possible that the plant may, like Stigmaria, prove to be the uppermost part of a root of some of the other forms" (*i.e.* of Lepidodendroid stems), "though I have never yet found it associated with any rootlets, and it may be a fragment from the base where stem and roots united" (*loc. cit.* p. 239). I arrived at the above conclusions because I found in the specimen described, evidence that large rootlet bundles were given off from the woody zone as in the true Stigmaria. But I affirm that out of hundreds of Stigmarian fragments that I have examined, I have only found two possessing this structure, and I unhesitatingly express my conviction that Mr. Binney's specimen is another example of an equally rare type, both being entirely distinct from *Stigmaria ficoides*, to which latter plant alone is referable Mr. Binney's previously published figures, M. Goeppert's description and figures of which Mr. Binney approves, and mine which he rejects.

Mr. Binney proceeds to say : "The size of these large vascular tubes or utricles in the medulla exceeding anything so far as his knowledge extended, hitherto observed in fossil plants, shows that it was easily decomposed, and thus accounts for the general absence of the medulla in Sigillaria and its roots." To this reasoning I must altogether demur. Size has nothing whatever to do with the preservation of the tissues in fossil plants. Vascular structures strengthened by transverse bars of lignine are equally well preserved, whether they are large or small. The medulla of Stigmaria disappeared or became much disorganised because it consisted of an unusually delicate cellular tissue with extremely thin walls. This tendency to decay was more manifest towards the centre of the medulla than at its circumference. Specimens on the table exhibit this peripheral part of the cellular medulla in exquisite perfection, giving off its characteristic cellular prolongations constituting the medullary rays, as described in my memoir. And yet this beautiful cellular tissue occupies the position which Mr. Binney says was occupied by "large vascular tubes or utricles." The specimens referred to showing these conditions constitute unanswerable facts.

Mr. Binney correctly notes the resemblance of the inner vascular cylinder in his specimen to his "medullary sheath." I have already said the same thing in several of my memoirs, and M. Brongniart said it before either of us. But this very homology, if correct, indicates the probability of Mr. Binney's specimen being a fragment derived from the junction of stem and root rather than a true root, since in living plants possessing a medullary sheath, that sheath, as every botanist knows, is never prolonged into the true roots, for the simple physiological reason that its origin is directly connected with that of the leaf formations of the ascending axis.

As I have already observed, M. Goeppert's and Mr. Binney's previous figures represent a structure altogether different from that now described by Mr. Binney. Instead of the continuous inner vascular cylinder of the latter, M. Goeppert's figure displays two detached, unsymmetrically arranged, vascular bundles in the interior of the medullary cavity. I have already affirmed my conviction that these belong to intruded rootlets of a Stigmaria, and are in no respects part of the true medullary axis. On the other hand, Mr. Binney says that "they are certainly not intruded rootlets, as anyone who examines the learned author's plates can satisfy himself." On this point Mr. Carruthers writes to me on Nov. 2 : "No one who is accustomed to sections of Stigmaria can fail to see that Goeppert has mistaken the accidental rootlets of Stigmaria penetrating the decayed axis for an organic part of that axis." I may allow this opinion of an experienced botanist, with which I wholly concur, to neutralise that of Mr. Binney, who further says : "It is very improbable that they" (*i.e.*, Goeppert's vascular rootlets) "had ever been introduced into the axis after the pith had been removed." To this I reply that it is an extremely rare thing to find any such axis which does not contain more or less of these rootlets. My cabinet is full of such examples, and in two specimens on the table, one of which has been lent me by Capt. J. Aitken, of Bacup, similar rootlets not only exist in the central axis, but have penetrated the medullary rays as in M. Goeppert's specimen.

Mr. Binney, referring to my comments upon his previous memoir, says that in "that memoir mention is only made of the large vascular bundles found in the axis, without calling them vascular or any other vessels." I do not very clearly understand what this sentence means, but I presume it is intended to imply that Mr. Binney never affirmed that the pith of Stigmaria contained vascular tissues, and that I have misrepresented him in stating that he had done so. I can only answer this by giving Mr. Binney's words :—"The most important circumstance thus developed is the existence of a double system of vessels in Stigmaria, first shown by Goeppert, and the consequent approach in this respect to *Diploxylon*, Corda. In Diploxylon, however, the inner system forms a continuous cylinder, concentric with and in juxtaposition to the wedges of wood forming the outer; while in Stigmaria the same inner system is broken up into scattered bundles, apparently unsymmetrically arranged in the medullary axis or pith of the plant" (*Quarterly Journal of the Geological Society*, vol. xv. p. 17) ; and on p. 78 of the same memoir, describing the specimen represented by Fig. 2, he says, "The axis is filled with eleven or twelve large vessels of circular or oval form," and the same structures are again spoken of as "vessels" no less than six times in the next seventeen lines, with the further remark that "altogether these angular vessels remind me somewhat of the vascular tissue in the middle of Anabathra" (loc. cit., p. 78). It is true that in two places Mr. Binney applies to these structures the term "utricles," by which, I presume, he means cells ; but such a term, applied to such tissues, is equally applicable to all known fibro-vascular structures, and is simply equivalent to saying that scalariform vessels have no existence.

I have entered into these details because by promulgating vague and groundless doubts respecting work already carefully done, Mr. Binney's communication tends to re-introduce confusion into questions that have been virtually settled. It does this through failing to discriminate between things that differ. His introductory remarks refer to the common *Stigmaria ficoides*, whilst his justification of those remarks rests upon a plant of a very different character, and which I am absolutely certain is not the common form of Stigmaria.

VEGETATION OF THE LIBYAN DESERT

IN Dr. Ascherson's report on the vegetation of the Libyan Desert, published in the *Botanische Zeitung*, there are some interesting notes on the fall and renewal of the leaves of deciduous trees. In our climate we have little difficulty in understanding the distinction between evergreen and deciduous trees and shrubs, because the greater part of those that change their leaves cast the old ones in autumn or early winter; and evergreens with flat leaves have them more or less coriaceous. But even with us there is a gradual transition from evergreen to deciduous through *Euonymus europæus* and *Ligustrum vulgare*, both of which have strictly evergreen congeners in *Euonymus japonicus* and *Ligustrum japonicum*. Some few years ago Hoffmann started a theory that sempervirence could be artificially produced, and there is no doubt that climate influences to a great extent the length of the period during which really deciduous species hold their foliage ; but it appears far more probable that these are physiological peculiarities not altogether dependent upon climate, as we find evergreen and deciduous species growing in the same regions and under precisely similar conditions. Some evergreens do not change their leaves at all, and even retain them for many years or all their lifetime ; *Araucaria imbricata*, for example. *Taxodium distichum*, one of the few deciduous Coniferæ, offers a very curious phenomenon, inasmuch as the ultimate branchlets are deciduous. The observations chronicled by Dr. Ascherson agree almost entirely with our own experience. On his outward journey he traversed 25° of lat. in less than a month, which gave him an excellent opportunity for studying the conditions of the same species under very diverse climates. Thus, in the plains of Lombardy many deciduous trees, and especially *Morus alba*, were still partially covered with foliage on the 19th of November, the same species having long previously shed their leaves in Germany. In a similar manner, the fig-trees in Lower Egypt (31° N. lat.) were partially clothed with foliage at the beginning of December, and in Upper Egypt (27° N.) were still in full leaf, whilst already, on the 24th of November, they were quite bare in the Apulian plain (41° N.). On the 11th of December, the pomegranate trees in the gardens of Siout were in yellow leaf, and on New Year's Day, 1874, the apricot trees at Farafreh were still in their prime of green leaf. Hence, one might readily imagine that on approaching nearer the equator these same species would exhibit no interval between the fall and the renewal of the foliage, and thus, to all intents and purposes, become evergreen. But this phenomenon was only verified in the case of the little cultivated peach trees of the oases, in which it may not be constant. Moreover, the peach tree shows the same tendency in mild seasons with us. In the oases, at the beginning of March, when the trees began to blossom and make new growth, the old leaves were still fresh and capable of assimilation. All other deciduous trees and shrubs cultivated in the gardens of Kasr Dghakel (25° 45′ N. lat.), including the grape-vine, apricot, apple, pomegranate, plum, fig, mulberry, and willow (*Salix safsaf*), had lost their foliage on the arrival of Dr. Ascherson, or became leafless before the end of January. It should be mentioned that the fall of the leaf in this region does not proceed with the same regularity as at home, for it is not unusual to see quite naked and fully clothed trees of the same species standing side by side. Again, the presence of abundance of moisture has the effect of enabling the trees to carry their old foliage longer and put forth their new earlier than trees growing in drier situations. And some of the willows growing by water were quite evergreen; that is, after the manner of the peach trees mentioned above. But the apricot, one of the most abundant trees, rarely retained even a few scattered old leaves on the appearance of the flowers. The same was observed of the grape-vine, fig, and mulberry. By Feb. 20 the apricot trees were in full blossom, and by March 10 in full foliage, so that there was only an interval of four or five weeks between the fall of the old foliage and complete development of the new. The apple and plum behaved in a similar manner, the pomegranate was a little later, the fig next in order, and finally the mulberry; whilst these same things, in the reverse sense, lost their leaves first. From the preceding notes it seems that the fall and renewal of the leaf is an essential constitutional peculiarity, which is modified by climatal conditions, but not entirely subject to them. A more striking illustration of this fact may be found in exotic deciduous trees planted in Egypt. Dr. Ascherson noted more particularly the summer fall of the leaves of *Poinsettia pulcherrima*, a South American shrub, and *Albizzia lebbek*, a native of the East Indies. The former is in the full splendour of its inflorescence in December, and quite leafless in April, remaining so, it is said, until the autumn. The Albizzia is extensively planted as an avenue tree. It sheds its foliage in April, but soon renews it. Both of these plants lose their leaves in their native countries during the dry, and renew them with the opening of the rainy season.

SCIENTIFIC SERIALS

Journal de Physique, III., No. 34, Oct. 1874.—This number commences with the first portion of a paper by M. J. Bertrand, entitled "Demonstration of Theorems relating to Electro-dynamic Actions." The object of this paper is to simplify Ampère's demonstrations of the théorems of electrodynamics.—Arrangement for obtaining projections of the metallic rays and their reversal, by M. Boudréaux. Instead of the electric light or oxyhydrogen flame, the author employs a mixture of the chlorate of the metal with one-sixth of its weight of powdered gum-lac. The mixture is inflamed in a carbon crucible placed in a lantern provided with a vertical slit. Reversals of the metallic lines are effected by allowing a beam of white light (Drummond or sun-light) to pass through the deflagrating mixture and analysing the resulting rays by prisms. By allowing the sun-light to fall only on one-half of the slit, the coincidence of bright with dark lines can be shown.—M. Mascart contributes a paper describing two pieces of apparatus for obtaining the phenomena of interference.—On the magnetisation of steel, by M. E. Bouty.—This number contains a translation of Lord Rayleigh's paper on the manufacture and theory of diffraction gratings from the *Philosophical Magazine* for February and March.—Sensibility of silver bromide to rays supposed to be chemically inactive, by H. Vogel, from *Poggendorff's Annalen*.—From the same journal there is a paper by H. Streintz, on changes in the length and elasticity of a wire under the influence of an electric current.—From the Proc. Roy. Soc. there are translations of Prof. Tyndall's paper on the transmission of sound, and Mr. Norman Lockyer's note on a new class of absorption phenomena.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie. Nov. 15.—In this number Dr. Hann treats of some of the consequences of the laws of change of temperature in air undergoing change of volume. The following are some of the results of his argument, which is full of interest. The rate of cooling of ascending air varies so much with the conditions of time and place that it cannot be expressed by any general law. But both in Germany and in the tropics the mean rate lies between 0°·5 and 0°·6 C. for every 100 metres. Air warmed at the surface of the earth does not continue to rise until it reaches a level where the temperature corresponds with its own (reduced), but becomes thoroughly mixed with other strata before reaching that height. Temperature falls more rapidly with increase of height in bad than in fine weather. In a descending current there can be no condensation of moisture, and so in it the theoretical increment of 1° C. does take place. We would expect this current to clear the sky. But in fact we find that a descending current often brings rain as well as warmer weather. Our moist west winds do not bring their moisture from the tropics, but the Anti-trade, becoming warmer as it descends, collects a fresh quantity of vapour and precipitates it again when cooled by radiation or ascent of mountain slopes. The formation of hail and phenomena of hailstorms are best understood by supposing, with Reye, the lower hot moist strata to rise rapidly to a great height, not the upper air to descend, as it has been shown that this would become much warmer in descending. A cold wind blows first in the higher parts of the atmosphere, and the over-heated air below rushes upward with unusual energy to a height where precipitated moisture freezes as it falls. This ascending movement of warm air, and the further impulse given to it by liberation of the latent heat of vapour, appear to play a large part in the production and continuance of falls of rain. Dr. Hann holds the barometric minimum in the middle of a storm area to be a mechanical effect of the whirling movement of the air, and the moving force in cyclones to be the latent heat of vapour.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Dec. 3.—"On the Coefficient of Expansion of a Paraffine of high boiling-point," by G. F. Rodwell, F.R.A.S., F.C.S., Science Master in Marlborough College. Communicated by Prof. Stokes, Sec. R. S.

The author, after giving an account of his researches, concludes that paraffine is a body which undergoes a most unusual expansion in passing from its ordinary solid condition to the high boiling-point which it possesses. He does not remember any other substance of a high boiling-point which occupies at the boiling-point a volume which is one-half as large again as the volume at the ordinary temperature. In an accompanying table he has introduced, side by side with the paraffine curve, the expansion curves of mercury, iodide of silver, and terbromide of phosphorus, one of the most expansible liquids known, if we except such bodies as ether, bromide of ethyl, acetate of methyl, &c., the boiling-point of which is below 100° C., and which, therefore, could not be easily introduced into the table for comparison with a body which boils at nearly 400° C.

Dec. 10.—"On the effect of Heat on the Iodide of Silver," by G. F. Rodwell, F.C.S. Communicated by Prof. F. Guthrie, F.R.S.

The author endeavours to prove the following main facts:—

1. That the iodide of silver exists in three allotropic forms, viz. (α) at temperatures between 116° C. and its fusing-point, as a plastic, tenacious, amorphous substance, possessing a reddish colour, and transparent to light; (β) at temperatures below 116° C. as a brittle, opaque, greenish-grey, crystalline mass; and (γ) if fused and poured into cold water, as an amorphous, very brittle, yellow, opaque substance.

2. That the iodide possesses a point of maximum density at or about 116° C. at the moment before passing from the amorphous into the crystalline condition.

3. That if we allow a mass of molten iodide to cool, the fol-

lowing effects may be observed :—(α) at the moment of solidification a very considerable contraction takes place ; (β) the solid, on further cooling, undergoes slight and regular contraction after the manner of solid bodies in general, until (γ) at or about 116° C. it undergoes sudden and violent expansion, passing from the amorphous into the crystalline condition ; (δ) after undergoing this expansion the mass on further cooling undergoes slight expansion, and (ε) the coefficient of contraction diminishes as the temperature decreases (or, otherwise expressed, the coefficient of contraction augments with the temperature).

"On the Multiplication of Definite Integrals," by W. H. L. Russell, F.R.S.

Geological Society, Dec. 2.—Mr. John Evans, F.R.S., president, in the chair.—The following communications were read :—On the femur of *Cryptosaurus eumerus*, Seeley, a Dinosaur from the Oxford clay of Great Gransden, by Mr. Harry Govier Seeley, F.L.S., Professor of Physical Geography in the Bedford College, London. The author described this femur as showing a slight forward bend in the lower third of the shaft, and as having the terminal portions wider in proportion to the length of the bone than in any described Dinosaurian genus. He pointed out its differences from the corresponding bone in Megalosaurus, Iguanodon, and other genera. The length of the femur was stated to be about one foot.—On the succession of the ancient rocks in the vicinity of St. David's, Pembrokeshire, with special reference to those of the Arenig and Llandeilo groups and their fossil contents, by Mr. Henry Hicks. In the first part of this paper the author described the general succession of the rocks in the neighbourhood of St. David's from the base of the Cambrian to the top of the Tremadoc group, and showed that they there form an unbroken series. The only break or unconformity recognised is at the base of the Cambrian series, where rocks of that age rest on the edges of beds belonging to a pre-Cambrian ridge. In the second part the author gave a minute description of the rocks, comparing the Arenig and Llandeilo groups, as seen in Pembrokeshire, with each other and also with those known in other Welsh areas. Each group he divided into three subgroups, chiefly by the fossil zones found in them. 1. The *Lower Arenig* was stated to consist of a series of black slates about 1,000 feet thick, and to be characterised chiefly by a great abundance of dendroid graptolites. 2. *Middle Arenig.*—A series of flags and slates, about 1,500 feet thick, and with the following fossils :—*Ogygia scutatrix*, *O. peltata*, *Ampyx Salteri*, &c. 3. *Upper Arenig.*—A series of slates, about 1,500 feet in thickness, only recently worked out, and found to contain a large number of new and very interesting fossils, belonging to the following genera, viz. : *Illænus*, *Illænopsis*, *Placoparia*, *Barrandia*, &c. 4. *Lower Llandeilo.*—A series of slates and interbedded ash, equivalent to the lowest beds in the Llandeilo and Builth districts, and containing species of Æglina, Ogygia, Trinucleus, and the well-known graptolites *Didymograptus Murchisoni* and *Diplograptus foliaceus*, &c. 5. *Middle Llandeilo.*—Calcareous slates and flags with the fossils *Asaphus tyrannus*, *Trinucleus Lloydii*, *Calymene cambrensis*, &c. 6. *Upper Llandeilo.*—Black slates and flags, with the fossils *Ogygia Buckii*, *Trinucleus fimbriatus*, &c. The Arenig series was first recognised in North Wales by Prof. Sedgwick about the year 1843, and was then discussed by him in papers presented to the Society. The Llandeilo series was discovered by Sir R. Murchison previously in the Llandeilo district, but its position in the succession was not made out until about 1844. The Geological Survey have invariably included the Arenig in the Llandeilo group ; but it was now shown that this occurred entirely from a mistaken idea as to the relative position of the two series, which were shown to be entirely distinct groups, the equivalents of both groups being present in Carnarvonshire, Shropshire, and Pembrokeshire, but the Llandeilo group only of the two being developed in Carmarthenshire. The lines of division in the series were said to be strongest at the top of the Menevian group and at the top of the Tremadoc group, these lines being palæontological breaks only, and not the result of unconformities in the strata.

Anthropological Institute, Dec. 8.—Mr. J. E. Price, F.S.A., in the chair.—Mr. M. J. Walhouse read a paper on the existence of a leaf-wearing tribe on the western coast of India. The author's residence at Mangalore for some years afforded him the opportunity of studying the habits of the native tribes of South Canara, and in the present communication he recorded a few facts concerning the Karagars, a remnant, now numbering only a few hundreds, of the aboriginal slave castes whose distinctive peculiarity was the habit of wearing aprons of woven twigs and green leaves over the usual garment. The custom at present is observed by the women only, who think that abandoning it will bring them ill luck. The author maintained that the leaf was a badge of degradation, and was a survival of a very ancient custom. The unswerving truthfulness of the Karagars is proverbial, and should be remarked as affording a complete refutation of Mr. Mill's assertion, that savages are invariably liars. The paper contained many interesting facts concerning the physical characteristics, traditions, religious rites, and habits of the tribe.—A paper by Mr. Rooke Pennington was read, on some tumuli and stone circles near Castleton, Derbyshire. It comprised a full account of the exploration of the barrow of Elden Hill, measuring 49 feet in diameter, which yielded bones of man, horse, and rat in great abundance, and a red deer's antler that had been worked. A few feet deeper was discovered a grave, containing the skeleton of a young person that had been buried in a contracted position ; no implements accompanied it, but it appeared to have been interred with much barbaric pomp. On the top of Siggett Hill was another barrow of somewhat less dimensions, in which was found a fine skeleton with an inverted urn, of the usual type, containing burnt bones. Evidence was adduced to prove that the corpse was not burnt until after the funeral feast was concluded, and the bones of the animals eaten were cast at the same time and into the same fire with the human body. This was one of those barrows which had led the author to conclude that in Derbyshire, at any rate, no connection can be established between the Neolithic age and contracted burial, and the bronze age and incremation.—Major Godwin-Austen contributed some further notes on the stone monuments of the Khasi Hills.

Mathematical Society, Dec. 10.—Prof. H. J. S. Smith, F.R.S., president, in the chair.—Prof. Cayley gave an account of his paper on the potentials of polygons and polyhedra.—Two notes from M. Mannheim to J. J. Sylvester, F.R.S., were, in the latter gentleman's absence, communicated by Mr. Tucker. The first note contained an elegant geometrical demonstration of the following propositions. $ABCD$ is a quadrilateral whose sides are of invariable magnitude, such that $ab = ad$ and $bc = cd$. The points a and b are fixed ; if m be a point rigidly connected with b, it will trace out, as the quadrilateral changes its form, the pedal of a conic. The problem has been treated in an analytical form by Prof. Cayley in a communication to the Society on the determination of the position of the node of a quartic curve, mentioned also in a paper read before the same Society by Mr. Samuel Roberts as a case of three-bar motion. This Mr. Cayley observed to be the inverse of a conic. Mr. Sylvester calls attention to M. Mannheim's proof as a very beautiful and purely geometrical one.—The second note is connected with a geometrical proof of a proposition thus stated by M. Mannheim :—"Lorsque le quadrilatère a, g, m, d, dont les cotés sont inégaux, mais dont les diagonales sont perpendiculaires entre elles, se déforment de façon que le sommet a décrive une circonférence (o) et les sommets g, d, des circonférences ayant même centre s sur la diagonale ma, le sommet libre m décrira une anallagmatique du 4^e^ ordre." This note relates to seven-bar motion, and is Peaucellier's motion, generalised by substituting for his rhomb any quadrilateral in which the two diagonals are at right angles, one case of which is the kite or spear-head form.

Royal Geographical Society, Dec. 14.—Major-General Sir H. Rawlinson, K.C.B., presided. The principal business was the reading of the report of the Livingstone Congo Expedition, by Lieut. W. T. Grandy, R.N. The President opened the proceedings by announcing the receipt of an interesting letter at the Foreign Office from Lieut. Cameron, the substance of which we have already given. Lieut. Cameron expressed his confident opinion, founded on Arab information, that the Lualaba river was in reality the Congo. Mr. Markham then read Lieut. Grandy's report, which was an itinerary of the writer's journey to the interior up to the date of his recall. Roads were being made by means of which the troops would be able to intercept the transit of slaves to the coast, and encouragement was being given to cultivate the india-rubber tree, of the value of which in Europe the natives had been hitherto ignorant. The chiefs had been exceedingly kind and hospitable to Lieut. Grandy and his party, and had promised facilities for future expeditions. He had found several traces of the Portuguese occupation of Congo, and he described the natives as being civilised, indolent, and exceedingly fond of snuff and tobacco. The palm-tree grew abundantly, but the principal use made of it by the natives was the distillation of the oil into a very intoxicating wine, in the use of which the king and chiefs indulged rather freely. Lieut. Grandy had shown his Majesty specimens of stearine, and he promised to commence its manufacture, instead of wine, from his palm oil. A terrible epidemic of small-pox was decimating Congo as Lieut. Grandy travelled through the country, and it almost entirely carried off his native porters and escort. In conclusion, the report described the Congo as being one of the grandest rivers in the world, and as being navigable for a distance of 110 miles from its mouth.

CAMBRIDGE

Philosophical Society, Nov. 30.—Prof. Humphry in the chair.—A paper on "Lopsided Generations," or "Right-handedness," by Dr. W. Ainslie Hollis, was read, which, judging from the abstract before us, contained little or no new matter. The author laid special stress on the statement that the left side of the brain in man is the larger, and that aphasia is connected with disease of that side; statements which, in the discussion which followed, Prof. Paget justly remarked were not yet in any way proved. The cases of Johnson and Swift were quoted as instances in which the left side of the brain had suffered, and paralysis of the right side had been induced, apparently as a consequence of overwork. Prof. Humphry and Mr. Carver both agreed that right-handedness was much a matter of education.—Dr. Wilson made a communication on the disposition of the peritoneum in man and other vertebrata, directing special attention to the peculiarities of the omental sac, which he showed to be frequently divided into two parts—a gastro-hepatic and a gastro-colic—by a constriction corresponding with the upper border of the stomach. One or more of the hepatic lobes usually project into the gastro-hepatic portion of the sac. In man, and we should therefore expect in others, it is the lobulus spigelii.

DUBLIN

Royal Irish Academy, Nov. 9.—William Stokes, F.R.S., president, in the chair.—Samuel Ferguson, V.P., read a paper on the Ogham-inscribed stone at Montaggart, Co. Cork. The author, in applying to this text, which had been considered undecipherable, the same method of translation adopted by the present Bishop of Limerick in the case of the Camp inscription, read it "Feqreq Moqoi Glunlegget," identifying Feqreq with the name Feàchra, as written by Adamnan, and assigning the meaning of "the Kneeler" to Glenlugget, which he took to be a name in religion; and expressed his belief that the monument is Christian.—A letter was read by the Secretary from Mr. R. R. Brash, commenting on Dr. Ferguson's paper.—Mr. H. W. Mackintosh read a paper on the muscular anatomy of *Cholœpus didactylus*.—Alexander Macalister, M.D., read a paper on two new species of Pentastoma. The first of these, *P. imperatoris*, was found in the lung and peritoneal cavity of *Boa imperator*, from South America; the second, *P. aonycis*, in the peritoneal cavity of *Aonyx leptonyx*, var. *B. major*, from the River Indus.—Alexander Macalister, M.D., also read a paper on the presence of a lachrymo-jugal suture in a human skull. Although the relation of the maxillary process of the jugal bone to the supra-orbital edge of the maxilla is subject to a considerable amount of variation, yet in the majority of cases this process ends at a point vertically over the infra-orbital foramen. But in one skull in the collection of Trinity College, Dublin, of which the history is unknown, the author found the maxillary process to stretch over the whole infra-orbital edge of the maxilla, in front of the large external hamulus of the lachrymal bone, with which it forms a suture of about a line and a half in length. The author further gives a sketch of the comparative anatomy of this suture.

PARIS

Geographical Society, Dec. 2.—President, M. Delesse.—Dr. Cosson declared himself decidedly against the scheme of forming a sea in the interior of Africa, on the site of the Tunisian "Chotts." He believes that not only would the climate of the Sahara be modified, but the great source of wealth of these regions—the culture of dates—would be completely destroyed. Moreover, the commercial results would never repay the enormous cost, estimated at about 12,000,000*l*. for Tunis, and a like sum for France. All the existing legitimate commerce is sufficiently carried on by means of caravans. It was, however, suggested that it would be wise to suspend judgment on the subject until the return of the French expedition, which is making preliminary investigations on the spot.—Dr. Hamy announced the discovery of new mines of gold in Australia, and of very ancient caverns which are expected to yield valuable results to geologists.—Dr. Harmand, one of the companions of the unfortunate Lt. Garnier, gave many interesting details concerning Tonquin.

Academy of Sciences, Dec. 7.—M. Frémy in the chair.—The following papers were read:—Memoir on the actions produced by the simultaneous concurrence of the currents from a battery and electro-capillary currents, by M. Becquerel.—Memoir on the intervention of physico-chemical forces in the phenomena of life, by M. Becquerel.—On the carpellary theory according to the Liliaceæ (*Yucca*), by M. A. Trécul.—On the swim-bladder from the point of view of station and locomotion, by M. A. Moreau.—Note on magnetism, by M. J. M. Gaugain.—On trials at acclimatising the "Jesuit's-bark" tree in the Isle of Réunion, by M. Vinson.—On the ureides of pyruvic acid; synthesis of a homologue of allantoïn, by M. Grimaux. In the present communication the author has examined the derivative obtained by the action of urea upon pyruvic acid. This body, named by its discoverer *pyvurile*, is a white crystalline substance of the formula $C_5H_8N_4O_3$. Treated with hydrochloric acid, it is converted into mono-pyruvic ureide, $CON_2H_2(C_3H_3O)$.—Application of illuminating gas to the pyrophone, by M. F. Kastner. The author's experiments show that if two or several isolated gas flames of convenient size are introduced into a tube of glass or other material at a distance of one-third of the length of the tube, reckoned from the lower extremity, these flames vibrate in unison, this phenomenon continuing as long as the flames remain separated, but ceasing immediately on their being brought into contact. The author likewise verifies the formation of ozone in the tubes.—Observations concerning species of the genus Phylloxera, by M. Signoret. The author publishes the following rectified synonymy:—*P. corticalis*, Kaltenb. = *Lichtensteinii*, Balbiani = *Rileyii*, Lich. MSS. Riley.—Method followed in searching for the most efficacious substance to oppose to Phylloxera at the viticultural station of Cognac, by M. Max Cornu.—Despatch from M. Stephan, director of the Observatory of Marseilles. This refers to the discovery on the 6—7 December of a new comet by M. Borrelly.—Occultation of Venus, eclipse of the sun and of the moon, observed during the month of October at Paris, by M. C. Flammarion.—Solution of the equation of the third degree by means of a jointed system, by M. Saint-Loup.—On two simple laws of the active resistance of solids, by M. J. Boussinesq.—Determination of the analytical relations which exist between the elements of curvature of the two *nappes* of the evolute of a surface, by M. A. Mannheim.—On the solutions of chrome alum, by M. D. Gernez.—On the transformations of persulphocyanogen, by M. J. Ponomareff. Phosphoric chloride appears from the author's researches to have the following action:—

$$C_3N_3S_3H + 3PCl_5 = 2PCl_3 + S_2Cl_2 + PSCl_3 + HCl + C_3N_3Cl_3$$

The action of ammonia has also been studied.—On the transport and inoculation of virus, carbuncular and others, by flies, by M. J. P. Mégnin. The author considers it demonstrated that certain flies, such as Stomoxus, &c., can be agents of transmission of certain virulent maladies—amongst others carbuncle.—During the meeting the perpetual secretary announced to the Academy that they had sustained a heavy loss in the person of Count Jaubert.

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DIARY OF SOCIETIES.

LONDON

THURSDAY, DECEMBER 17.

ROYAL SOCIETY, at 8.30.—On Polishing the Specula of Reflecting Telescopes: W. Lassell, F.R.S.—Note on the Vertical Distribution of Temperature in the Ocean: J. Y. Buchanan, Chemist on board the *Challenger*.

LINNEAN SOCIETY, at 8.—Observations on Bees and Wasps: Sir John Lubbock, Bart., M P., F.R.S.—Diagnoses of New Genera and Species of Hydroida: Prof. Allman, Pres. L.S.

CHEMICAL SOCIETY, at 8.—Grove's Method of preparing Chlorides: C. Schorlemmer, F.R.S.—On the Precipitation of Metals by Zinc: J. Davies.—Researches on the Paraffins existing in Pennsylvanian Petroleum: T. Morgan.—Some remarks on the preceding paper: C. Schorlemmer.

MONDAY, DECEMBER 21.

SOCIETY OF ARTS, at 8.—Cantor Lecture; Alcohol, its Action and Use: Dr. B. W. Richardson, F.R.S.

TUESDAY, DECEMBER 22.

ANTHROPOLOGICAL INSTITUTE, at 8.—On early Modes of Navigation, tracing the Development of Ship Forms: Col. A. Lane Fox.

WEST LONDON SCIENTIFIC ASSOCIATION, at 8.—Sketch of the Anatomy of Insects: B. Thomson Lowne, F.Z.S.

LEEDS

MONDAY, DECEMBER 21.

GEOLOGICAL ASSOCIATION, at 8.—Exhibition of Specimens and Conversation.

MANCHESTER

TUESDAY, DECEMBER 22.

GEOLOGICAL SOCIETY, at 3.

TORQUAY

MONDAY, DECEMBER 21.

NATURAL HISTORY SOCIETY, at 12, noon.—Transit of Venus: W. Pengelly, F.R.S.

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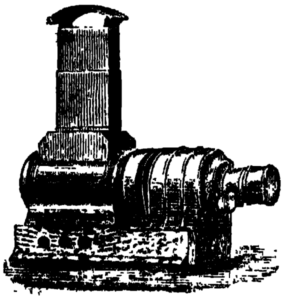

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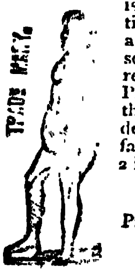

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THURSDAY, OCTOBER 1, 1874

HINTS ON MEDICAL STUDIES

FEW of those who to-day commence their medical education will be able fully to realise what would have been their position if they had done the same some fifty years or more ago, instead of now. After an apprenticeship of from three to five years to a country practitioner, during which time, at the expense of their general education, they would have been employed in dispensing medicines, and other less honourable duties, they would have entered on their medical studies, properly so called, possessing a certain empirical acquaintance with a few of the details of professional life, which might however, have been obtained in an infinitely shorter time after the principles of the subject had been mastered.

This state of things is fortunately past. The pupil now leaves school, having had a more liberal general training, conducted mostly during the time which used to be wasted in apprenticeship, and after being tested by a commencing examination in Latin, arithmetic, &c., he immediately begins his special studies at a recognised college and hospital. At the outset several questions respecting the direction that his work has to take, suggest themselves, which are only partially answered in the calendars of the different examining bodies, and on which there is considerable diversity of opinion amongst teachers and the profession generally. One of the most important of these refers to the question whether or not it is advisable to commence clinical work at once, or to wait until some knowledge of anatomy and physiology has been obtained. As the medical education consists of two parts, a theoretical and a practical, one conducted in the lecture-theatre and the dissecting-room, the other in the wards, out-patient department, and post-mortem theatre of the hospital: is it wise to pursue these two independent courses simultaneously, and if not, which should have the preference? This question is not difficult to answer, for it is evident that attendance in the wards of the hospital during the first medical session must very much resemble the justly disparaged period of apprenticeship. Like it, the knowledge acquired will be almost entirely empirical, and therefore so much the less useful; for the numerous facts which the student is learning from the classes he is attending at this early period, must for some time be so crudely associated in his mind that he will experience difficulty enough in retaining them there at all, let alone having to apply them to previously unexpected instances. We therefore would advise that the first winter session at least should be entirely devoted to lecture-work and the dissecting-room, and that the wards should not be systematically visited until the following summer. Then, even, as Materia Medica is not a winter subject, but little can be learnt with reference to treatment, except in surgery; experience in diagnosis must consequently be the only object kept in view. Afterwards, as much time as can be spared may be devoted to clinical work.

Another question which requires an answer refers to the number of subjects which ought to be embraced in the necessary course of study. Without wishing at present to enter into a discussion as to whether the vital force which is at work in the living body is anything *sui generis*, or only an elaboration of other well-known forces which are manifested by inorganic matter, there is no doubt that those physiological phenomena which are within the reach of complete human comprehension are all capable of being represented as problems of pure physics. Such being the case, the great importance to all thinking students of medicine, of a knowledge of the fundamental properties of matter, must be self-evident. Some may have had the opportunity of learning a little about mechanics, heat, light, and electricity at school, but most will be sadly ignorant on these subjects; and being so, when they have advanced sufficiently far in physiological and pathological investigation to appreciate the enormous fields for work which they open up, they will find no greater stumbling-block to their further progress than their imperfect training in the science of physics; it will act as a barrier against sound original work in all directions, and prevent many an able man from doing full justice to his mental capacities.

It is this unsoundness of the physical basis of physiology which maintains the considerable interval between physiologists and physicists; which makes it necessary to have physiological and physical laboratories as separate institutions instead of as different departments of the same establishment, and which allows flagrant physical inaccuracies in physiological investigations to be stated and restated under the approving sanction of those who ought to know better. What can horrify a pure physicist so much at the present state of physiological knowledge as, when he reads in a recently published work by one who is considered to be the British representative of the subject on which he treats, to learn that in the flight of birds the wings strike downwards and forwards; and in another work, by another prominent author, that the aortic valves, which correspond to the secondary valve of an ordinary pump, close *during* the contraction of the ventricles of the heart? Similarly, the phenomena of electrotonus, in the eyes of a physicist, have as little to do with the true nerve-current as the spark obtained from a Leyden jar has with that circulating in an ordinary electric telegraph cable. These instances, and many others which might be adduced, all point to the importance of a thorough knowledge of physics to the student of medicine.

Second only to physics, as a collateral part of medical education, is zoology. Many, however, would place botany next. No doubt a knowledge of botany is essential to a thorough comprehension of the details of Materia Medica; nevertheless, for the prosecution of work bearing on medicine proper, an acquaintance with the structure of animals is more important than that of plants. The latter may, most of it, be left to the pharmaceutical chemist, and be neglected by the physician. Very little is gained by the medical student when he learns that podophyllin is obtained from the rhizome of a ranunculaceous plant, or even that the natural order Solanaceæ has been divided up in a manner which physiological action justifies: but that the cæcum of the intestine is absent in many mammalia, and that it is of very much larger proportionate size in some than in man, must have an important bearing on our conception of the function of that organ. Many other similar instances might be given, all proving the importance of comparative anatomy in a medical point of view; and it is almost certain that before long that science will have a more prominent position in medical education than it at the present time possesses.

Those who have no other aspirations than to follow the routine practice of their profession immediately their few years of education are completed, will no doubt ignore the value of the extended curriculum we advocate: they imagine that it does not conduce to more accurate diagnosis or more correct treatment. This view is a short-sighted one, to say the least; for though the most able theorist may, by chance, be a bad practical physician or surgeon, yet the good he does by his higher work is insuperably greater in the long run than the immediate relief of individual cases. It is by the progress that is made by the profession in obtaining the mastery of disease that its position is maintained in society generally, and this progress is due much more to the theoretical chemist and physiologist than to the successful practitioner who simply follows the ordinary routine of his calling.

NOMENCLATURE OF DISEASES

Nomenclature of Diseases, prepared for the use of the Medical Officers of the United States Marine Hospital Service, by the Supervising Surgeon. (Washington: 1874).

THE preparation of this volume by Dr. Woodworth, supervising surgeon, has consisted in adopting, with some important omissions and unimportant transpositions, a literal transcript of the original "Nomenclature of Diseases" drawn up by a joint committee appointed by the Royal College of Physicians of London, of which Dr. Sibson was the editing secretary.

The original work received a modified sanction from the British Government, inasmuch as by the remarkable liberality of Mr. Lowe, then Chancellor of the Exchequer, money enough was provided to print off a large edition, and transmit a copy gratis to every member of the medical profession in Great Britain and Ireland. The further diffusion of the work in the United States by Dr. Woodworth is a thing for which the profession owes that gentleman hearty thanks. The work, indeed, seems to be more authoritative on that side of the Atlantic than on this; for the statistics of mortality for the ninth census of the United States were made up in accordance with its arrangement. This extension of a uniform nomenclature is itself, apart from the merits of the work, an evident great gain to science.

It is proposed to give the book a decennial revision; but while revision of some kind is periodically necessary, we do not anticipate that, after the work is thoroughly matured, it will be required above once in a generation,—three or four times in a century.

In the meantime, the book is in a somewhat imperfect state, many inaccuracies having been pointed out in a report upon it by the Edinburgh College of Physicians. The correction of such errors and the bringing of the work to the level of the present state of medical science will make it mature for the time being. But we hope that a new generation of medical men will find it necessary to revise it; not to correct common errors, but to adapt it to the then advanced state of medical science. We are doubtful as to the propriety of attempting work of this kind by a mixed committee. The committee should be of the only kind Dr. Chalmers could tolerate—a committee of one! only the one should have power to call in aid. The work of Linnæus or of Jussieu could not have been done by a committee.

A good nomenclature of diseases will inevitably represent the science of the day. According as science advances, so will the nomenclature and arrangement be more and more natural. The profession of medicine is to be congratulated on the felt want of a nomenclature temporarily fixed, and on the evidence this work affords of its generous ambition to rise above a mere nosology, to something like a natural pathological arrangement.

The wide diffusion of a book like this in the medical profession, besides its own immediate utility, is sure to exercise a very beneficial and much wanted scientific influence. The looseness of much professional writing will be diminished and precision encouraged. If medical terms are well defined, writers will naturally become more careful in their use of them. At present, medical writing is infested not only with ill-defined terms but indefinite description. How often do we see such phrases as "once or twice," when we should have "once" or "twice." We might give many examples of this looseness for which we tolerate no excuse; but there is a looseness arising from the imperfection of medical science which we must meantime tolerate. Good and precise definition of terms only becomes possible when we know the properties or peculiarities of what is to be defined, and medicine is as yet in too empirical a state for satisfactory definitions. That subdivision of it which is most advanced—pathological anatomy—illustrates well the growth of precision of terminology as advancing knowledge permits and demands it, definition and discovery going hand in hand.

The same branch of medicine affords the best illustration of an admirable struggle after a good nomenclature, but even for this branch there has not as yet arisen a Tournefort to produce, if not temporary unanimity, at least temporary union in regard to nomenclature—a deficiency which, however much to be deplored as a cause of confusion and error, implies blame to no one. If in morbid anatomy we have no established nomenclature, how can we expect it in the nosology? This department of medical nomenclature we regard as being meantime best left in what may be called its popular state, such names as scarlatina, erysipelas, cholera, thrush, being better than any that could be based on our present imperfect knowledge of these diseases. But although this may be so now, there is good reason to expect the day when good descriptive names will be found for all these diseases—names which will suggest to the instructed an epitome of what is known regarding them.

Such suggestive names cannot be, however, without a well-matured classification. At present there are several very natural but isolated classes of diseases which form good samples of what is wanted—zymotic diseases, parasitic diseases, mechanical injuries—but for the most part we have a disjointed catalogue rather than a classification. The attainment of a complete classification will be a great step, an index of progress and an aid to it; but it

will be a structure, as we have already said, that advancing science will periodically overthrow. The ruin, however, will not be deplorable, because not only not irreparable, but certain to be succeeded by a new edifice which will in all probability be better and more useful than its predecessor. J. M. D.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Education of Women

In your excellent article (vol. x. p. 395) on this subject, you forcibly point out that custom and prejudice have established for boys and girls a curriculum of studies which seems to have but little reason to justify it. You particularly mention that whereas music is, in England, but rarely taught to boys, it is "almost compulsory on girls, whether they have the talent for it or not."

This monopoly of music for girls, supposing our system of education to be founded on reason, should imply, amongst other considerations, that females possess peculiar aptitudes for this branch of art, and that instructing them in it is more likely to produce favourable results in their case than in that of males. I do not say that this is the only probable justification for our practice, but it should certainly be one strong ground for it.

But how does the matter really stand? It is a most remarkable fact that in the highest walk of musical achievement, composition, women are positively nowhere. I believe I am safe in saying that not a single opera, or oratorio, for instance, the work of a woman, has ever maintained even brief popularity; nor has the sex furnished us with one representative worthy of being placed by the side of Bach, Handel, Mozart, Beethoven, Rossini, Mendelssohn, and a host of other great male composers who could be named.

In almost every other department of art and knowledge eminent women have been found—in literature, both prose and poetic, in mathematics, science, painting, sculpture, medicine; but not a solitary great female musical composer can be named.

I do not point out this fact for the purpose of disparaging the female intellect, of which I have the highest admiration, but for the purpose of reinforcing with it the arguments put forward by yourself and other friends of female education in favour of a revision of the subjects appropriated by unreasoning custom to the two sexes.

Considering, however, that the doctrine of chances might have been expected to give us at least one female musician of the highest order out of the myriads who devote a large portion of their existence to the cultivation of the art, the striking fact that it is not so is one well calculated to excite speculation. Is the power of producing new and acceptable music distinguishable in any way from other art power—that for instance of producing a fine painting, statue, or poem? There does seem to me to be this peculiarity belonging to music. The subjects of a painting, statue, or poem, may, and generally are, suggested by some event, person, tradition, or thing already existing. The suggestions of colour, form, light, and shade, furnished by nature, are endless, and capable of infinite diversification—they often, no doubt, act on the mind of the artist unconsciously—but, whether he is conscious of it or not, their influence is always at work—and though he produces something which we feel to be truly original, yet he is probably indebted for the first germ of the idea and for the greater part of the machinery by means of which it has been realised, to sources and materials previously existing, some of which have indeed generally left their traces on the work.

Can anything like this be said of music? What can have suggested some of the simple melodies to which we are never tired of listening, and which are so complete, so consistent, so satisfying, that we accept them almost like works of nature which we do not dream of altering? That there are associations of ideas between musical sounds and visible things, and even moral sentiments, may be true, but such relations must be vagueness and mistiness itself, compared with the relations on which other arts are dependent. So slight, so remote, so intangible are the sources of original music, that it has always seemed to me that the faculty of musical composition of the highest order approaches more nearly to inspiration, than any other faculty with which mankind is endowed.

How can the apparent absence of this faculty in women be explained? ALEX. STRANGE

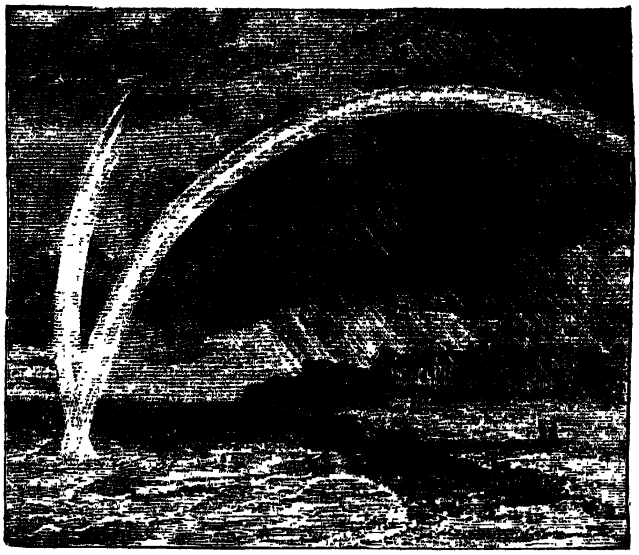
London, Sept. 22

Double Rainbow

On the 11th, at 5.40 P.M., this comparatively rare phenomenon was well seen here by the crowd assembled at the Ladies' Golf Match. The accompanying sketch, by T. Hodge, Esq., gives a thoroughly artistic view of the scene.

Unfortunately the estuary of the Eden, whose quiet water furnished the reflected sunlight, is considerably north of the observer's station. Hence the necessary incompleteness of the second bow. I cannot learn whether any spectator was fortunate enough to observe the phenomenon from a point a mile or two north, whence it would probably have been seen entire.

As seen from stations to the eastward of St. Andrews, the second bow, there due to light reflected from the rougher water of the bay, was considerably broader than the first; so much so at the upper end of the visible portion as to give, even to intelligent spectators, the impression that it was convex instead of concave to the point opposite the reflected sun.



It was not possible to ascertain whether the light of the portions of the two bows visible below the horizon was that coming from the rain-drops directly, or that subsequently reflected from the sea; though (*pace* Dr. Tyndall) probably the latter was at least a considerable agent. P. G. TAIT

St. Andrews, N.B., Sept. 15

P.S. In my note on "Bright Meteors" (NATURE, vol. x. 305) I find I have inadvertently written Saturday in place of Sunday. Perhaps, with this correction, Mr. Waller may be able to identify both meteors in a satisfactory manner.

This is the phenomenon observed by Dr. Halley, Aug. 6, 1698, at Chester. The second bow was formed by the sun's light reflected from the river Dee. See "Brewster's Optics," p. 380.

Of the parts of the two bows below the horizon, the outer is a continuation of the primary bow, and is formed principally by direct sunlight striking the drops between the observer and the sea and reflected in the ordinary manner.

It may derive a slight increase of brightness from light first reflected at the sea, then by rain-drops, and lastly by the sea again. The inner part is produced by one reflection from the sea and one reflection from rain-drops. The brightness will be the same whichever reflection comes first, provided the smooth sea, the rain-drops, and the sunlight are present.

J. CLERK-MAXWELL

Curious Rainbow

I do not see that the rainbow described by Mr. Swettenham (NATURE, vol. x. p. 398) was different from an ordinary rainbow of moderate brightness, except in there being a slight interval between the two series of colours, which generally blend into one another. The fainter series are attributed to interference. In bright rainbows there are three, if not four, series of colours, at least in the upper part of the arch, where the colours are always the most distinct, probably owing to the rain-drops being smaller high up, and therefore more perfectly globular. It may not be generally known that a rainbow may be seen much more perfectly in a single drop of dew, by placing the eye close to it, than in rain, and then no less than ten or twelve series of colours may be seen; and in the irregular dew-drops (as also in hoar-frost) a great and very beautiful variety of bows and spectra can be seen. T. W. BACKHOUSE

Sunderland, Sept 23

I SHOULD like to say a few words regarding Mr. Swettenham's letter (NATURE, vol. x. p. 398). The mathematical theory of the rainbow has been worked out pretty completely. We must not look for it, however, in text-books, which generally give a very unsatisfactory account of the rainbow, but in the original memoirs, which sometimes are very difficult to find.

The appearance of coloured bands inside the primary rainbow is not at all of very rare occurrence; since my attention has been drawn to them by a casual observation, I have seen them repeatedly. Only a few weeks ago I saw distinctly three concentric bows, with all the colours inside the primary bow. These bows have been called supernumerary rainbows. The complete mathematical theory has been given by the Astronomer Royal in the *Philosophical Magazine*, and the theory has been verified by Mr. Miller. The cause of these coloured rings is the interference of two rays of light entering the rain-drop at different angles of incidence, but having the same deviation, and therefore leaving the rain-drop parallel to each other. It is clear that two such rays must exist for all deviations from the maximum to the deviation of ray of light having an angle of incidence of 90°.

In text-books no mention is ever made of these supernumerary rainbows, and this is the more to be regretted as the interference mentioned above is, I think, one of the principal causes of its formation.

Were the explanation given in text-books complete, we should not have in the rainbow such pure colours as we actually see, but the yellow would contain a great deal of red, and the green would be contaminated by a great quantity of red and yellow. As it is, however, the red, which would have the same deviation as the green and yellow rays, is destroyed, or nearly so, by interference, which, therefore, is the cause that the colours of the rainbow are nearly pure. What is called the violet of the rainbow is generally the violet mixed with the red of the next supernumerary rainbow. This is not the only instance that text-books contain incomplete accounts of phenomena which have been satisfactorily explained. ARTHUR SCHUSTER

Sunnyside, Upper Avenue Road

Mist Bows

ON Sept. 14 I was driving from the Lizard just after sunrise with Mr. Lugg of Manaccan. A thick mist covered the fields and moorland. The tops of the farm buildings and corn stacks and the church towers were visible above the sea of mist which, matted on the ground, gave the entire country the appearance of being covered with snow. About 6.30 A.M. the sun was bright on our right hand, and on the left we saw a halo of prismatic colours forming a distinct circle of rainbow at a little distance from and encircling the shadows of our heads, and only broken where the shadows of our bodies interposed. This appearance lasted for ten minutes, and our shadows with their attendant bow showed brightly against the mist background as we passed hedges and fields, and kept pace with us like "the mist raised from the plashy earth" by the hare in Wordsworth's poem,

> "That, glittering in the sun,
> Runs with her all the way wherever she doth run."

We afterwards opened a valley terminating in an extensive moor, when the mist appeared as a sea of prismatic colour extending to the horizon. About 7 A.M. we saw a perfect bow free from any prismatic colour, both ends of which terminated in the field immediately to our left.

My companion, who is constantly driving about this district in early morning, says he never before saw similar phenomena.

Lizard Signal Station, Sept. 16 HOWARD FOX

Carnivorous Plants—how to be obtained

IT is not unlikely that there may be a great demand for plants of the genus Drosera, and as I am in a neighbourhood where the supply of the *D. rotundifolia* and *D. intermedia* is inexhaustible, I shall be glad to send, through the post, plants of the same to any who are desirous of investigating their carnivorous habits; but to meet the necessary expenses of collecting and postage, six penny stamps must be enclosed in the application for each dozen plants. The applications of dealers in plants will not be attended to.

The *D. intermedia* is far more abundant than the *D. rotundifolia*, and will answer the purpose of investigators quite as well. A few words about the method of growth of these may not be out of place. Pure peat well soaked with water suits either kind, but while the *D. intermedia* flourishes with its roots beneath the surface of the water, *D. rotundifolia* grows best when it is from 3 in. to 4 in. above the surface; now and then it happens that it is found with its roots in the water, and then the hairs on the stalks of the leaves, which constitute one of the distinguishing features between these species, are much diminished, both in number and length.

The Liverpool naturalists will find a large supply of the *D. rotundifolia* on Oxton Common, and there they are most abundant in the corner nearest to Noctorum Farm. Thurstaston Hill is another locality in the same neighbourhood where this plant grows.

The *Pinguicula lusitanica* is not uncommon in the bogs of the New Forest, but I cannot promise specimens of this plant with the same certainty as I can those of the Droseræ. Applications for plants had better have the word *Drosera* written on the envelope, to prevent the delay which would arise from such letters being forwarded to me when away from the New Forest.

Bisterne Close, Burley, Hants G. H. HOPKINS

[Both species are moderately abundant, though small, in a peat-bog near Burnham Beeches, Bucks, about four miles from Slough.—ED.]

Automatism of Animals

PROF. HUXLEY'S most interesting address published in NATURE, vol. x. p. 362, seems to me to involve some difficulty, which I take the liberty to state, though well aware that I am stepping on slippery ground. I allude to this passage:—"Suppose I had a frog placed in my hand, and that I could make it, by turning my hand, perform this balancing movement. If the frog were a philosopher he might reason thus: 'I feel myself uncomfortable and slipping, and feeling myself uncomfortable I put my legs out to save myself. Knowing that I shall tumble if I do not put them further, I put them further still, and my volition brings about all these beautiful adjustments which result in my sitting safely.' But if the frog so reasoned he would be entirely mistaken, for the frog does the thing just as well when he has no reason, no sensation, no possibility of thought of any kind."

Now, does it unavoidably follow from the latter fact that this philosophising frog would be *entirely* mistaken? What I should venture to object is simply this:—Experiment shows, indeed, that very delicate combinations of muscular actions (as in swimming) are brought about by impressions upon the sensory nerves, even when, after ablation of the brain, there can be no longer any consciousness. But have not those combinations originally arisen during undisturbed consciousness, and therefore, perhaps, under the influence of consciousness, inscrutable as the relation of consciousness to corporeal phenomena is acknowledged to be? And even if the experiments alluded to should succeed with animal individuals which, before vivisection, never had executed the movements in question (and I was once assured by a distinguished physiologist that similar experiments do really succeed with rabbits deprived of part of brain soon after birth), yet those adjustments may be rather considered with regard to the great principle of inheritance, as it has been applied to instincts by Mr. Darwin and Mr. Spencer, and alluded to in Prof. Tyndall's address. Though now performed by animals without possibility of sensation and thought, those movements were adjusted to each other, and to impressions on sensory nerves in these animals' ancestors while in possession of consciousness.

Surely such questions will ever remain doubtful; yet I think it not unbecoming to state a view of them which seems to me to be in accordance with the present direction of biological theories. I. D. WETTERHAN

Frankfort-on-the-Maine, Sept. 20

Photographic Irradiation

I hope you will allow me space to correct a slight misunderstanding which has got into the present discussion on photographic irradiation. Mr. Crofts (Nature, vol. x. p. 245) places my views in opposition to those of Lord Lindsay and Mr. Ranyard. Mr. Stillman (Nature, vol. x. p. 381), who has given us such valuable information on the molecular condition of different preparations of collodion, also takes the same view. Now in reality Lord Lindsay's and Mr. Ranyard's views are not opposed to mine. I have simply attempted to prove that molecular reflection was *a cause* of photographic irradiation, not that it was *the only cause*, as I quite agree with Lord Lindsay and Mr. Ranyard, that the imperfections of the lens are also causes of photographic irradiation, and in Nature, vol. x. p. 185, I pointed out one form of irradiation due to the lens. But the imperfection of the lens which is most fatal is that pointed out by Lord Lindsay and Mr. Ranyard, namely, the inability of the lens to bring all the rays to a focus, whether this results from the imperfections of the outside portion of the lens, or from imperfect achromatic[*] correction. No maker of lenses will tell you that any lens, far less that every lens which he puts out, is perfectly corrected for dispersion. Working with such an instrument, it is very clear that if we only allow an exposure sufficient to give an image on the part of the collodion where the great proportion of the rays are focused, then the photographic impression will give very nearly the true boundary line. But suppose we allow more light to pass through the lens, either by turning the camera to a brighter light or by giving a longer exposure, then it is clear that the unfocused rays which gave no impression when the exposure was short, will now impress themselves on the collodion, and thus the photographic impression will be extended beyond the true boundary line.

That there should be difference of results in experiments on photographic irradiation is quite to be expected, as there are so many variables in the experiments. The light, temperature, and condition of the collodion are all constantly changing, and the conditions under which the experimenters work, and the apparatus and chemicals used, are different for each experimenter; different results may therefore be expected. If the experimenter use a good lens, and employ only the central portion of it, the imperfection due to the lens may be small in quantity. But if his lens is imperfectly shaped and badly corrected for dispersion, and he uses the full aperture, the result will be very different. Again, if the experimenter work with different collodions, Mr. Stillman has shown that, altogether independent of the lens, a very slight change in the preparation of the collodion greatly alters the amount of irradiation. So far as I can at present judge, the imperfections of the lens and molecular reflection are not opponents, but allied enemies, which we must meet on the same field. John Aitken

Darroch, Falkirk, N.B.

Can Land-crabs Live under Water?

When in Atchin, in Sumatra, during the second Dutch expedition, it occurred to me to put to experimental test a statement which I thought I had seen in some book or other—this book turns out to be Prof. Marshall's work on "Physiology"—to the effect that land-crabs are drowned when kept immersed in water.

On one occasion I kept one of these crabs under water for two hours, after which time it was as lively as ever; and on another day a larger specimen was kept submerged for exactly four hours, after the lapse of which time it was somewhat subdued, but by no means moribund.

Unfortunately the duration of my experiments was always limited by the necessities of ablution, as our largest receptacle for fluids was a small-sized Huntley and Palmer's biscuit-tin, which served as our only washing apparatus, as well as the laboratory—eventually a very leaky one—for my experiments, for a period of four months spent under an equatorial sun.

New University Club, Sept. 22 J. C. Galton

Salivary Glands of Cockroach

I see in Nature, vol. x. p. 381, a letter on the salivary glands of the cockroach, by Dr. W. Ainslie Hollis, in which he remarks:—

"As far as my experience carried me, the sacculi, the supposed reservoirs of the saliva, never contained naturally any liquid whatever, but on opening the thorax were invariably found to be collapsed and empty."

A few days ago I was observing some of these creatures. I examined several shortly after they were caught; in these the sacculi were empty, but others which I had kept alive in a cup with only a few drops of water for a day or two, had invariably the sacculi distended with liquid.

I will not attempt to explain these facts, but leave that to others more capable than myself. Chas. Workman

Belfast, Sept. 21

THE AUSTRIAN POLAR EXPEDITION

The Vienna correspondent of the *Times* supplies some interesting details concerning this important expedition. Events have proved that there has not been an expedition better fitted out, as to ship, stores, or crew, than that in which this North Pole Expedition left Bremerhaven on June 13, 1872.

As to the crew of twenty-four men, it was composed of three naval officers, Lieutenants Weyprecht and Brosch and Ensign Orel; two engineers, and fifteen picked Dalmatian sailors; Lieut. Payer, of the Jägers, an Alpine Club man, with two Tyrolese mountaineers; Halier and Kletz, and the Hungarian Képesy as surgeon. It was thus calculated for land work not less than sea work, and events proved that the company had been well sorted.

The object of the expedition being to find a north-easterly passage towards the coast of Siberia, the expedition having arrived at Tromsoe, and having taken on board Capt. Carlsen as harpooner and ice-master, started on the 14th of July for the sea and the coast of Novaya Zemlya. At Novaya Zemlya they met the Norwegian yacht *Jsbjörn*, in which Count Wilczek and Baron Sternberg, two of the chief promoters of the expedition, had come over from Spitzbergen to establish a store for them near Cape Nassau. They were for two years the last human beings they saw. The stores being laid in a cleft of the rocks inaccessible to the Polar bears, and the state of the ice looking more promising, the ships parted company on the 21st of August, the *Tegethoff* going north, the *Jsbjörn* south. The hope proved to be fallacious long before evening. The *Tegethoff* was icebound, and never was got out again. The temperature sank, copious snowfalls cemented the loose ice-fields, and the *Tegethoff* was surrounded by a solid mass of ice.

In this precarious state the ship lay for five months, the ice freezing together and bursting in turn, and so exposing it perpetually to fresh pressure. All was prepared for leaving the ship. The stores were brought on deck and a portion placed on the ice. This was the most trying time of the whole. Every moment the alarm was sounded and the signal given for leaving the ship. It was sufficient to wear out the strongest. In spite of this, meteorological and other observations were carried on. The strain on the mind told on the state of health in spite of all precautions, and scurvy and pulmonary affections set in.

All this time the ship was being driven in a north-easterly direction until, towards the end of January, 1873, 73 W. long. and 79 lat. were reached on February 25. The sun appeared again after five months on the horizon, and on the 25th the pressure of ice ceased. A massive wall had been formed round the ship, protecting it from further injury. The drifting was now to the north-west. Milder weather having set in, the hope revived of setting the ship free, and for five months the work went on. By dint of boring and blasting the fore part of the ship was made free, but to free the aft proved impossible, ice of 30 ft. thickness lying underneath.

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[*] We here require some new word, or we must greatly extend our conception of achromatism, as we have here to deal with rays far beyond the limits of the sensitiveness of the eye; and the word achromatic, as applied to lenses for chemical purposes, is somewhat misleading. I may here offer two suggestions as to how the imperfect power of the lens to bring all the different rays to a focus may be partially corrected:—(1) By using a collodion which is as nearly as possible only sensitive to those rays which the lens can bring to a focus; or (2) by providing each lens used for making accurate observations with a screen, which shall stop back all the rays beyond the limits which the lens can focus.

Disheartened, the expedition had almost resigned itself to have to pass another winter in the same position, when, on the 31st of August, high land was seen in the north, some fourteen nautical miles off. The feeling at first of great joy at the unexpected discovery became soon a torture. To be so close and not to be able to get to that unknown land. At last, towards the end of October, the ship drifted to about three miles off one of the islands which lay before the main land, and there the ship froze in at the beginning of November, and lies still in 79° 51′ N. lat. and 58° 36′ W. long. Here the winter of 1873-74 was passed in comparative quiet.

During the time a series of highly interesting astronomical, meteorological, and magnetical observations were made. The Northern Lights were very numerous and magnificent—white, red, and green, with crowns, bands, and rays of great size and brilliancy. The needle was so disturbed that oscillation became the rule and steadiness the exception. The cold was more intense than the year before, there being 37° Réaumur below zero on the ship. But the supply of fresh bear's meat and the absence of that strain on the mind produced by constant danger kept the crew in better health. The reappearance of the sun on the 24th of February did the rest for all except Krisch, the engineer, who died of consumption on the 17th of March, and was buried in the newly discovered land, between two basalt columns; for the explorations had already begun.

A first expedition of Payer, the two Tyrolese, four sailors, and the only three dogs remaining started for the mainland, went up the promontories named Tegethoff and M'Clintock, 2,500 ft. high, and up the Nordenskjold Fjord, bordered by the large Souklar glacier. It was still very cold, 40° Réaumur. All was still white with snow and hoar-frost, making the symmetrical rock columns look like candied sugar.

The second expedition of thirty days started on the 24th of March. The temperature had risen, but snow-drifts, wet, and the breaking up of ice made the journey still more dangerous. Of course, before getting the map it will be impossible to form a clear image of the configuration of the country. The atmosphere over the ice being hazy, the only way for making observations was by going to the heights, and by these means a succession of points was established—Cape Koldewey, 80° 15′; Cape Frankfurt, 80° 25′; Cape Ritter, 80° 45′; Cape Kane, 81° 10′; and Cape Fligely, 82° 5′, all on the Austria Sound. The diminished stores and the short available time necessitated forced marches, so one-half of the party was left under a rocky eminence in 81° 38′, and Payer, Lieut. Orel, the sailor Zaninovich, and the three dogs started to cross Crown Prince Rudolf's Land. Undeterred by a dangerous accident, the expedition went on by a roundabout way to the coast, and along it again northward. The progress became more and more difficult and dangerous; it was all fresh ice, often not more than a few inches thick. From Cape Fligely, the most northerly point touched, another elevated point, named Cape Wien, was sighted in 83°, the most northerly point of the known earth. Then the journey back again was more dangerous than the advance, but on the 25th of April the ship was seen on the spot where it had been left.

After a few days' rest, very much wanted, a third expedition was made, again to the west—like the first—when a high mountain, Cape Brünn, 40 miles from the ship, opened out a view over the mountainous country, with the Humboldt Peak, about 5,000 ft. high, as its culminating point.

Already, in March, a council had been held, and the decision had been come to to abandon the ship and to try to make their way back on sledges and boats. On the 20th of May the colours were nailed to the masts of the ship, and the expedition started with three boats and as many large sledges. The exertions proved almost too much. The journey had to be made five times over, three times tugging at boats and sledges, then twice back again. The continual south wind driving the ice northward seemed to make all efforts to get south useless, and after eight months' toil it seemed as if nothing remained but to return to the ship and pass there another winter. In the second half of July, however, north winds set in with rain, loosening the ice, and breaking it up, until on the 13th of August the expedition got into free water. It was in the unusually high latitude of 77° 40′. Had it not been for this exceptionally favourable state of the ice, the impression is that the expedition would not have been able to return. Now there was the pulling for the land. The crew and officers, divided into two watches, took it in turn day and night, so that forty miles' progress was made daily. On the second day the mountain of Nowaja Saulja was sighted. There were still provisions for a fortnight. A portion was left on shore, and then the southern bays were searched for Russian fishermen. None were found at the Barents Islands; bad weather set in, the sea ran high, all were wet through and unable to pull. It was already settled that the White Sea was to be made if no ship was found up to the 28th. However, on the 29th, two fishermen were sighted in a boat belonging to the schooner *Nicolay*, which brought the expedition to Vardöe on the 2nd of September.

The new land, as far as discovered, is about the size of Spitzbergen, and consists of several large masses intersected by fjords and surrounded by islands. A large passage called the Austria Sound separates these masses and forks under 82° north latitude into a north-easterly arm, which could be followed up to Cape Pest in the furthest north. The mountains are dolomitic. Their middle elevation is from 2,000 to 3,000 feet, only towards the south they may rise up to 5,000. All the depressions between the summits are occupied by glaciers of gigantic size, as they only occur in arctic regions. The vegetation is much poorer than that of Greenland, Spitzbergen, or Novaya Zemlya, and in the south, except for Polar bears, it is devoid of animal life too. Several attempts were made to pass through the country, but they were found impossible, mountains barred the road, so progress was tried along the coast line, and the more the explorers penetrated north by west the more the temperature rose, and the coasts of Crown Prince Rudolf Land were found to be tenanted by myriads of birds, elks, &c., traces of bears, foxes, and hares appeared, and seals lay on the ice. In spite of the treacherous nature of the road, it was continued to 82° 5′, where, at Cape Fligely, a wide expanse of water only covered with ice of recent formation was seen. In spite of this the explorers think the open Polar sea a delusion. Without raising a theory about the possible connection of this new land with Gillis Land in the south-west, the opinion is that it bears out up to a certain point Peterman's assumption of an inner arctic archipelago.

The fact of the expedition having found *hares* in the newly discovered land seems significant of a channel, not invariably frozen in winter, between Franz-Joseph Land and Spitzbergen, since hares do not occur in the latter.

In Norway the members of the expedition were received with the greatest enthusiasm, at Hamburg they were welcomed like bringers of good tidings, and on their entry into Vienna they could not have received a greater ovation had they been the remnant of a conquering army. All this they have richly merited, and there can be no doubt that Lieutenants Payer and Weyprecht have won for themselves a place in the first rank of arctic explorers.

A second Austrian Arctic Exploring Expedition is being prepared at Vienna to start next summer. One half of the expedition will seek to advance to the north, under Lieut. Payer, by way of East Greenland, and the other half, under Count Wilczek, will proceed *viâ* Siberia. The object of the expedition is to ascertain if the newly-discovered Franz-Joseph Land is a continent or an island.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE twenty-third meeting of this Association, which commenced at Hartford, under the presidency of Dr. J. L. Le Conte, on Aug. 12, seems to have been a successful one. Apart from the regular growth in prosperity which is exhibited every year, there was the unusual accession of the chemists, who have resolved to make their science strongly represented, and there was the excitement and interest which attended an important change in the constitution of the Association. The nature of the change we have already indicated (vol. x. p. 382). There was an unusually large attendance of the most eminent American representatives of science. The Association meets at Detroit next year on the second Wednesday of August.

The president's address consisted chiefly of allusions to some of the principal scientific events of the year, and of a summary of the matters to come before the Association. At a later period of the meeting the retiring president gave his address, in which he reviewed the progress of scientific instruments and methods. We can only refer very briefly to some of the more important papers read.

In a paper *On the Periodicity of the Rainfall in the United States in Relation to the Periodicity of the Solar Spots*, by Prof. John Brocklesby, the author concludes from his investigations that in the United States there is a connection existing between rainfalls and variations in the sun-spot area; the rainfall rising above the mean when the sun-spot area is in excess and falling below it when it is deficient.

Differential Measurements of Solar Temperature, by Prof. S. P. Langley of Pittsburgh, Pa. After stating the aims of the Alleghany Observatory at Pittsburgh, and giving details of the work now carried on there, consisting largely of observations and photographs of the sun, Prof. Langley said that there is a very wide variation in both the heat and light, and probably also in the actinic force of different parts of the sun. The difference is due principally, but not wholly, to differences in atmospheric absorption. Prof. Henry observed that the image of a sun-spot is colder than the photosphere surrounding it. Secchi has shown that the heat of the sun diminishes as we approach its edge, and he thinks that there is a different temperature at the sun's equator and the poles. Prof. Langley gave details of his own experiments with a thermopile upon these points. He finds that the observation of Prof. Henry is correct. But comparing the image of the spot with the photosphere immediately surrounding it, he finds that the image of a spot not far from the centre is uniformly warmer than that of the edge. To get the full significance of this observation we must consider that the image of the same spot is at the same time darker and colder than the photosphere near the centre, and darker and warmer than the photosphere near the edge. A series of measurements of the heat from the centre to the edge were made.

It does not appear as the result of these experiments that there is so great a selective absorption of heat in the lower regions of the sun's atmosphere, that when rays come from the edge of the disc and pass through a greater proportional thickness of his atmosphere, the heat is filtered from them and the light allowed to go through. We find that the heat falls away so very rapidly towards the edge as to indicate a much greater thinness of the solar chromosphere than has been hitherto admitted. We appear to have been led to the conclusion that there is a local obscuration over the spot very remarkable both in degree and kind. Prof. Langley exhibited a photograph of a sun-spot that looked, he said, like a sketch of a crystallising substance; when, however, we consider the enormous areas involved, we find the analogies of crystallisation wholly fail us, and we may more probably account for the facts by a hypothesis of cyclonic action. He concluded by pointing out the great value of these studies in connection with investigations in terrestrial meteorology.

Distribution of the Poles of Nebulæ, by Prof. Cleveland Abbe, of Washington. The general problem attacked in the present paper is the question whether there are planes that have a definite relation to nebulæ.

It may in general be stated that the positions of planes of rotation among the nebulæ do not show any such uniformity as is the case with the solar system: on the contrary, they are at all possible angles with each other. But there is this remarkable feature: that their nodes cluster about a point in R.A. 12h. 45m. and declination 60° N., that point being the North Pole of the plane near which lie the majority of the so-called axes of rotation.

Cave Fauna of the Middle States, by Prof. A. S. Packard, jun., of Salem, Mass.—For about a month during the last part of April and early in May last, Prof. Packard was engaged with Mr. T. G. Sanborn in exploring the caves of Kentucky under the auspices of the Geological Survey of that State, Prof. Shaler accompanying Prof. Packard. They first examined the Mammoth Cave, and doubled the number of animals known to exist therein and in others adjoining. An exploration, with Prof. Shaler, of the Carter Caves in Grayson County, Ky., also revealed a rich fauna composed of twenty species. Prof. Packard also examined Wyandotte Cave alone, and found a wingless Procus and two species of Thysanura new to the cave. Several caves within sixteen miles of New Albany, Ind., at Bradford, were examined. Finally, a careful examination of Weyer's Cave, in Virginia, and the adjoining Cave of the Fountains revealed a fauna containing some twenty species, no life having been previously reported from those caves.

These results show a great uniformity in the distribution of life—more than would at first be expected, though these caves lie in a faunal region nearly identical as regards the external world, and the temperature of the caves is very constant. Still some notable differences occurred.

Change by Gradual Modification not the Universal Law, by Thomas Meehan, of Germantown, Penn.—After adducing many instances in support of the theory that new forms are often generated by "leaps," Mr. Meehan concludes with the following propositions:—1. Morphological changes in individual plants are not always by gradual modifications. 2. Variations from specific forms follow the same law. 3. Variations are often sudden and also of such decided character as to seem generic. 4. These sudden formations perpetuate themselves similarly in all respects to forms springing from gradual modifications. 5. Variations of similar character occur in widely separated localities. 6. Variations occur in communities of plants simultaneously by causes affecting nutrition, and perhaps by other causes. Mr. Meehan argues from these premises that new and widely distinct species may be suddenly evolved from pre-existing forms without the intervention of connecting links.

This paper provoked considerable discussion. Prof. Morse said that the impression seemed to prevail among a great many that Prof. Meehan's paper was an argument against Darwinism, while in reality, in whatever sense you look at it, it was a corroboration of the theory of evolution. Prof. C. V. Riley insisted that most of the circumstances cited by Prof. Meehan found their parallels in what were generally known to zoologists as well as botanists as "sports" or even "monstrosities," and that Mr. Darwin himself had instanced some of the most interesting cases.

Prof. Asa Gray remarked that he only wished to state in respect to variations occurring abruptly as they did, that those certainly were not the kind of things which Mr. Darwin would have regarded as in any way interfering with his view, and he did not think Mr. Meehan had rightly comprehended the statement to which he had called attention. "I think (pursued Prof. Gray) that the statement, whatever it is, taken in connection with the remark which Mr. Riley made, and which Mr. Darwin a good deal insists upon, viz., that he does not look to monstrosities for the introduction of new forms, because the monstrosities may be expected to be taken out of relation to the surrounding circumstances, and that it is only those modifications which are in relation to surrounding and changing circumstances that can be utilised and turned to account—is not to be found fault with. Mr. Darwin distinctly notes that monstrosities may be hereditary, and so may be supposed even to be continued if they were sufficient in relation to surrounding circumstances. So, if Mr. Darwin readily takes into his view changes like that which everyone calls monstrosities, he may readily be expected not to regard it as any infringement upon the maxim that varieties should come into existence quite abruptly with considerable differences. I think it is true that varieties are apt to arise in that way with very considerable differences, and so true that those surely are not the kind of things to which Mr. Darwin looks as difficulties to overcome, but as stepping-stones in his way."

Glacial Phenomena in the Sierra Nevada, by Prof. John Muir, of Oakland, Cal.—The studies of Prof. Muir referred particularly to that portion of the Sierra which is embraced between lat. 36° 30′ and 39°, which measures about 200 miles in length by about 60 in width, and attains an elevation along the axis from 8,600 ft. to nearly 15,000 ft. above the sea. All the individual mountains distributed over this vast area, of whatever kind, have been brought into relief during the glacial epoch by the direct mechanical action of the ice-sheet and the glaciers into which it afterwards separated. The chief phenomena presented are:—(1) scratched and polished surfaces, (2) moraines, (3) moutonned rock-forms, and sculpture in general, as seen in valleys, ridges, lake basins, and separate mountains.

The paper goes on to describe the lofty mountains distributed along the summit of the portion of the Sierra under consideration, which are almost wholly unexplored—Mounts Dana, Lyell, Whitney, and Tyndall. The Pinnacles, which are the smallest of the summit mountainets, are described in an interesting way, the author concluding that instead of each being formed by special upheaval, or supposing that the chasms which separate them were made by subsidence, they were formed by the removal of the materials which once filled the intervening chasms. The same truth applies to the larger peaks, and the author concludes this branch of his subject by saying that they are all residual masses of the once solid wave of the entire range, and all that would be required to obliterate their distinctive character would be the restoration of the materials which have been carried away.

The next inquiry is, what has become of this material, not the millionth part of which can now be seen? and the author answers himself with the statement that glaciers were the transporting agents, and that in forming the basins and valleys in which they flowed, they carved out the summit peaks. This is so important a proposition as to demand careful attention to its proof. This proof is brought forward in detail. Subsequently, granting this proposition to be true from the proof, the author is obliged to go on to show what force or forces have sharpened the crests, which bear no trace of glacial action, and which were probably always above its reach. Next is considered the formation of special groups of mountains, and the geological effects of shadows—in prolonging and intensifying the actions of portions of glaciers, as shown in moraines, lake basins, and in the difference in form and sculpture between the north and south sides of valleys and mountains; especially as to their effects in the segregation of mountain masses. Also as to the effect of physical structure upon surface features, and the cause of the absence of well-marked individuality in summit mountains.

Prof. F. W. Clarke, of the University of Cincinnati, read a paper *On the Molecular Volume of Water of Crystallisation*. He stated that, to the chemist, it is important to get at some distinguishing character between water of crystallisation and true water of hydration. This character may be found by a study of the molecular volumes of various hydrated compounds. If we determine the molecular volume of frozen water, that is ice, we shall find it to be 19·6. If that water unites to form a hydrate or a crystalline salt, contraction ensues, and by studying that contraction we get at curious results. In the case of water of crystallisation, Prof. Clarke has studied over thirty salts, and in every case the molecular volume of the water is about 14. With water of hydration no such regularity is found. Evidently, then, when water unites with an anhydrous salt from water of crystallisation, all the condensation which occurs is on the part of the water, the volume of the molecule of the salt itself remaining unchanged.

Prof. Clarke also read a paper *On the Molecular Heat of Similar Compounds*. Prof. Clarke said that it is commonly thought that similar compounds have equal molecular heat. This is only approximately true. In comparing about twenty series of similar compounds, Prof. Clarke finds that the molecular heat increases slightly with the molecular weight, though in a very different ratio. In comparing all the extant determinations of specific heat, he has found only two or three exceptions to this rule, and even they were doubtful.

Prof. R. E. Rogers, of the University of Pennsylvania, read a *Notice of Prof. A. K. Eaton's new Compound One-prism Spectroscope*. The instrument is the invention of a Brooklyn chemist, and is by himself named "a direct-vision spectroscope." It consists of a thick plate of glass with parallel sides, united to one of the faces of an ordinary bisulphide of carbon prism, or a prism of dense flint-glass. According to the amount of dispersion desired, the light is made to enter either on the end of the glass plate or on the opposite face of the bisulphide prism. The results obtained from this instrument are as follows:—The dispersion of this compound prism is nearly four times greater than that of the ordinary 60° prism. The mean emergent ray is practically parallel to the incident ray. It does not deflect the ray from its original path. Many Frauenhofer lines are visible by this prism with the naked eye, while with the observing telescope all the prominent lines are clearly reversed, without the use of the slit or collimator, by merely throwing a strong beam of light by means of a mirror.

Dr. J. H. Mellichamp, of Bluffton, S.C., gave an account of some recent observations at Bluffton upon the *Sarracenia variolaris*, which abounds in that locality. This species of the pitcher plant has an elongated, conical, erect leaf, with a broad lamina curved over the opening, and a wide longitudinal wing upon one side the whole length of the tube. The upper portion is veined with purple, the intervening spaces being white and diaphanous. Dr. Mellichamp establishes the following points:—The base of the tube secretes a watery fluid, which is not sweet nor odorous, but which proves quickly fatal to all insects that fall into it. The whole inner surface is covered with very minute prickles, perfectly smooth and pointed downward, which render it impossible for an insect to ascend by walking, even when the leaf is laid nearly horizontal. Within the somewhat dilated rim of the tube there is a band half an inch in width, dotted with a sweet secretion, attractive to insects, but not intoxicating. This also extends downward along the edge of the outer wing to the very ground, thus alluring many creeping insects, and especially ants, to the more dangerous feeding-ground above, where, once losing foothold, it is impossible to regain it. Even flies escape but rarely, the form of the tube and lid seeming to effectually obstruct their flight. As the result, the tube becomes filled to the depth of some inches with a mass of decaying ants, flies, hornets, and other insects. Within this there is always found a white grub feeding upon the material thus gathered, perhaps the larva of a large fly which has been observed to stand upon the edge of the tube and drop an egg within it. Soon after the full development of the leaf the upper portion becomes brown and shrivelled, which is due to still another larva, the young of a small moth, which feeds upon the substance of the leaf, leaving only the outer epidermis, and works its way from above downward till in due time it spins its cocoon, suspending it by silken threads just above the surface of the insect *débris* at the bottom. The whole forms a series of relationships and an instance of contrivance and design, the full purport of which is still by no means fully understood. Other species of the genus, as also the allied Darlingtonia of California, manifest the same purpose of insect-capture, whatever the final object may be.

As complementary to Dr. Mellichamp's paper, Prof. C. V. Riley gave an account of his investigations on the insects more particularly associated with *Sarracenia variolaris*, which we shall reprint separately in an early number.

Number and Distribution of Fixed Stars is the title of a paper read by Prof. B. A. Gould, of Cambridge, Mass. The great work of Argelander undertook no less than a complete census of all stars in the northern hemisphere to the ninth magnitude inclusive, with as many as possible of the magnitude 9½. This was successfully executed, and an association comprising the great majority of northern observatories is now employing the working list thus obtained for the construction of a catalogue to fix star-places with the utmost attainable accuracy. The magnitudes are given to the tenth of a unit, from a number of observations on each, in the published catalogue, after having been first estimated by half units.

Prof. Littrow of Vienna made a careful enumeration of stars for each magnitude, to ascertain whether an approximate uniformity in the distribution of stars was indicated. If the magnitudes depend upon distances from us, and the stars are distributed with uniformity in space, the number of stars of any given magnitude should be proportioned to the spherical area within which they are observed. The truth of the hypothesis may be inferred from the degree of accordance between the numbers of stars of given magnitudes in the catalogue, and numbers computed from the contents of imaginary spherical shells whose radii would correspond with the respective magnitudes. An approximate indication might be obtained of the relative distances of each magnitude. Notwithstanding the difficulties which are incident to this method, due to inevitable errors of observation and comparison, Littrow believed that a sufficient degree of uniformity was demonstrated to justify faith in the general theory that there is a considerable degree of uniformity in the distances of the fixed stars within his investigation, and that there is warrant for applying his formulas—the results of his research—to regions outside of his limits. Discussing the numbers in Argelander's catalogue assorted by units as far as the eighth magnitude, he obtains the fraction 0·423 for the ratio of brilliancy between stars of two successive magnitudes; assorted by half units, the fraction is (including 8½) 0·431. Each computation gives the distance of a star of the eighth magnitude as 18, that of a star of average first magnitude being taken as a unit. The discordances between the results given by the empirical values of the formula and those from the enumeration of the catalogue are large, amounting to 39 per cent. for stars of the fourth, and 44 per cent. for stars of the ninth magnitude.

The recent completion of our Argentine Uranometry determines the actual magnitudes for all stars easily visible to the naked eye throughout the heavens. Prof. Gould thinks it improbable that the error of individual magnitudes exceeds the tenth of a unit. Prof. Heis has revised and extended Argelander's work to the nearest third of a unit for all stars visible in Central Europe with the naked eye, his lowest limit being 6⅓. The Argentine work furnishes similar data with respect to the stars in the southern hemisphere. Prof. Gould has carefully studied the results of Littrow's enumeration, is convinced of the accuracy of his computations, and accepts his formula as the best obtainable. Prof. Gould has extended a similar comparison to all the stars in the heavens of the sixth magnitude, using the numbers and magnitudes furnished by the uranometries, and obtains the value of the constant as 0·482. The accordance of this with observations may be judged from the following table:—

NUMBER OF FIXED STARS.

Magnitude.	Argelander.		Uranometries.		Whole Sky.	
	Count.	Formula.	North'n.	South'n.	Observ.	Formula.
1	6	4	8	6	14	23
1½	4	4	7	4	11	16
2	22	8	25	20	45	29
2½	12	15	35	33	68	50
3	51	26	55	41	96	85
3½	66	53	103	87	190	149
4	128	99	132	108	240	257
4½	140	186	254	154	408	444
5	379	350	392	240	632	768
5½	493	658	696	563	1,259	1,329
6	1,242	1,230	1,374	1,075	2,449	2,300
6½	2,231	2,372	—	2,022	—	3,976
7	4,668	4,362	—	3,317	—	6,879
7½	6,378	8,107	—		—	11,900
8	14,525	15,402	—	-		20,582
8½	28,480	26,037	—	—	—	35,601
9	78,185	51,370	—	—	—	61,582

The columns under "Argelander" give the numbers obtained respectively by enumeration and by the formula thence deduced, from the *Durchmusterung*, and, of course, apply only to the northern hemisphere. The columns under "Uranometries" are deduced from Heis's *Atlas Cœlestis* for the northern sky and from the Argentine Uranometry for the southern. Under the "Whole Sky" the first contains the sum of northern and southern stars from the columns immediately preceding; the second the numbers computed on the hypothesis of uniform distribution in space and equal brilliancy. Comparing these numbers with those obtained from the *Durchmusterung*, the latter must of course be doubled.

The carefully determined numbers of bright stars from the Uranometry afford no greater support to the hypothesis than those obtained from the *Durchmusterung*. While a general similarity between the numbers of count and of theory is apparent, the accordance is sufficient to warrant deductions which are not essentially vague. Still the approximate accordance, as far as it goes, may furnish us with a constant magnitude ratio for crude estimates in cosmical inquiries.

If we assume, according to hypothesis, an equal number of stars in each hemisphere, there are altogether not less than 15,300 stars as bright as the seventh magnitude. But since the count indicates an excess of bright stars in the northern sky, there may be a thousand more, as given by the formula. The numbers of the *Durchmusterung* imply the existence of over 200,000 stars as bright as the ninth magnitude, though the magnitudes of faint stars in that work seem given on the average a little too bright. The average distance of ninth magnitude stars seems to exceed 25. The manifest agglomeration of faint stars in the Milky Way shows the inapplicability of the hypothesis to stars fainter than a certain magnitude. The limit of applicability is probably considerably beyond stars of the seventh magnitude or distances twelve times the average of first magnitude stars. There is no contradiction in all this to the well-known fact of accumulation of brighter stars in certain regions.

With regard to the belief that the number of stars of any given magnitude diminishes with their distance from the Milky Way, Prof. Gould says that in the clear atmosphere of Cordoba the existence of a bright stream of stars was very noticeable, including Canopus, Sirius, and Aldebaran, with the most brilliant ones in Carina, Columba, Canis Major, the Pleiades, &c., and skirting the Milky Way on its preceding side. On the opposite side of the galaxy the same was true, the bright stars fringing it in a stream that leaves it at Alpha and Beta Centauri, comprises the constellation Lupus and a great part of Scorpio, and extends onward through Ophiucus toward Lyra. Thus a great circle or zone of bright stars seems to gird the sky, intersecting with the Milky Way at the Southern Cross, but far more conspicuous on the other. The northern intersection of this zone Prof. Gould finds in Cassiopeia, which is diametrically opposite to the Southern Cross. The right ascension of the northern node is 0 h. 50 m.; the southern 12 h. 50 m.; the declination about 60°, and very near the points where the great circle of the Milky Way has its maximum declination. The inclination of this stream of stars to the Milky Way is about 25°; the Pleiades occupying a point just midway between the nodes. Prof. Gould after making this discovery found that it had been partially anticipated by Sir John Herschel, so far as the recognition of a portion of the zone was concerned. The two classes of considerations—the approximate method furnished by the hypothesis of an equable distribution of stars, and the existence of a well-marked zone of very bright stars as much inclined to the Milky Way as the equator is to the ecliptic, may assist in determining the position of our sun with reference to its own cluster, that of the cluster itself, and the scale of distances between its constituent stars.

Prof. Wright read two papers on cognate subjects, one *On the use of Natural Twin Crystals of Quartz in the construction of Polariscopes*, and *On the nature of the Zodiacal Light and the distribution of matter which occasions it.*—Prof. Wright gave reasons for doubting whether the hypothesis of bodies rotating around the sun in all directions, and within the orbit of the earth, will account for the zodiacal light. The observed form of the zodiacal light is consistent with the supposition that the reflecting bodies move in long orbits—*i.e.*, orbits of great eccentricity.

Small Brains in Tertiary Mammals.—Prof. Marsh compares the mammals of the Eocene, Miocene, and Pliocene, with the result that in the case of the animals observed, Dinoceras and Brontotherium, a very distinct and remarkable development of brain from the lower to the higher formations.

Summer Dormancy of Butterfly Larvæ, by Prof. C. V. Riley, of St. Louis.—In this paper the author, referring to Mr. S. H. Scudder's paper in the *American Naturalist* for Sept. 1873, gave the results of his observations on the larvæ of *Phyciodes nycteis*, some of which appear to remain in a dormant state through the summer and succeeding winter.

The Disintegration of Rocks, by Prof. T. Sterry Hunt, of Boston.—This subject the speaker had noticed briefly in a communication to the Association last year on the geology of the Blue Ridge. The change of the rocks in question is a chemical one, which is the most obvious in the case of crystalline rocks; the feldspar loses its alkalies and part of its silver, being changed into clay, and the hornblende its lime and magnesia, retaining its iron and peroxide. From this results a softening and decay, to greater or less depths, of the strata, so that while they still retain their arrangement, and are seen to be traversed by veins of quartz and metallic ores, the strata are often so much changed to depths of one hundred feet or more from the surface as to be readily removed by the action of the water.

Fog Signals and Transmission of Sound, by Prof. Joseph Henry, of Washington.—Prof. Henry does not exactly accept the deductions recently made by Prof. Tyndall, having himself observed a large number of similar phenomena, and attributing them to refraction, not absorption, of sound by wind and other causes. Prof. Henry found Tyndall's explanation, that a mixed atmosphere absorbed sound, inadequate to explain the facts. The practical interference, and therefore the practical absorption, must be very inconsiderable compared with the volume of sound. In the case of the syren, such is the intensity of the sound that it would cause sand to dance on a stretched membrane at a distance of one-and-a-half miles, while a 2500-pound bell would not set the same sand in motion at a distance of thirty yards.

It has been frequently observed that a distinct echo is sometimes obtained from the ocean. Prof. Tyndall thinks the reflection is from surfaces of wind. Prof. Henry thinks it is from the surface of the waves of the ocean, and that the sound is afterwards refracted by the wind.

In a paper *On the Tails of Comets*, Mr. Henry M. Parkhurst endeavours to give data for predicting the form and appearance of these appendages.

Thermo-electric Properties of Minerals, by Professors A. Schrauf and E. S. Dana.—The interesting investigations of the late Gustave Rose, an eminent mineralogist at Berlin, have, during two or three years past, excited considerable interest in this subject. He began with the fact first announced by Hankel that some crystals of pyrite and cobaltite are electrically positive and others negative, and the endeavour to explain this opposite character on the assumption that it was connected with a condition of the right and left hemihedrism characteristic of both species. This touches a fundamental point in molecular physics, and if it could be sustained, Rose's hypothesis would be very valuable.

Schrauf and Dana, however, after the examination of a large number of minerals, comprising nearly all the metallic sulphids, have come to the conclusion that the cause of the variation of electrical character in this species must be sought elsewhere. They attribute it not to an opposite molecular condition shown in the hemihedral crystals, but to a change in chemical composition. They call their attention, in the first place, to the series of Seebach, where, for example, platinum occupies a varying position according to its degree of purity; moreover, they urge that the single case observed by Stefan, where some specimens of granular galena are positive and others of crystallised galena negative, is strong evidence against the influence of hemihedrism, as nothing of the kind can be assumed here. The force of their argument lies in the fact that they have found several other well-defined cases of minerals having peculiar varieties, and that among minerals crystallising holohedrally. Chemical analyses were here desirable to show how far the material under investigation varied in composition. In the absence of these, however, the specific gravity was resorted to as an indicator of the chemical character.

This afforded decisive results of plus and minus varieties of species, showing a decided difference in density and implying a corresponding change in composition. This was true also, in a marked manner, of cobaltite, and in a somewat less degree of pyrite, showing in each case where the explanation for the electrical character was to be looked for.

Several other conclusions were deduced from the long list of observations contained in the paper, but the foregoing will be sufficient to indicate its principal points.

Distribution of American Woodlands, by Prof. Wm. H. Brewer, of New Haven.—The flora of the United States, the author said, is believed to contain over 800 woody species, and over 300 trees. Of these trees, about 250 species are somewhere tolerably abundant, about 120 species grow to a tolerably large size, 20 attain the height of 100 ft., 12 a height sometimes of over 200 ft., and a few—perhaps 5 or 6—a height of 300 ft.

Notes on Tree Growth, by Prof. Asa Gray, of Cambridge, Mass.—Whether the trunk of a tree increases in length, in the parts once formed, is still an open question in the popular mind. From careful observations made by Prof. Gray and many others, the conclusion is that the trunks of trees do not grow in length.

Natural History at Penikese, by Prof. F. W. Putnam.—In speaking of the method of teaching at Penikese School, Prof. Putnam said:—"Text-books are not allowed. Our way was to give each student a specimen of fish and ask him or her to study that fish and tell the instructor what had been observed. Thus we developed their powers of observation upon the external character of the fish. After they had studied the fishes for about two days, they were called upon to state what they had seen. Then the anatomy of the specimens was gone into, and the students were led on step by step until they had secured a very firmly founded idea of the structure of a vertebrate animal. Then we asked questions as to the character of vertebrates, and finally they began to be original investigators. We really demonstrated in a practical way the subject, which is exciting so much attention now, of co-education of the sexes. We found that the ladies of the school were as capable in every way of making careful dissections and rendering careful accounts of the work they had done as the gentlemen, and, in fact, four or five of the ladies became original investigators before any of the gentlemen. This showed conclusively that the ladies had the power of becoming original investigators in science if they only would give the application."

Organic Change produced in the Bee, by Sophie B. Herrick, of Baltimore.—This was a very interesting paper, containing the authoress's own observations and experiments on bees.

The Reversion of Thoroughbred Animals, by Prof. Wm. H. Brewer.—It is often claimed that if the care of man be withdrawn an improved breed will retrace the steps of its ancestry and revert to its original characteristics. For some years Prof. Brewer has been investigating this subject and seeking for proof of the alleged tendency to reversion. To carefully-worded inquiries in writing, following upon every report of such "reversion," Prof. Brewer has received very numerous replies, and they are unanimously in the negative. This is certainly remarkable, following upon the confident assertions that animals so frequently exhibited the alleged tendency. The inquiries were pushed in the specific localities where the reversion was said to have occurred; the questions have been put to a large number of stock-breeders, and finally have been made by means of a printed circular. But the result was always the same, except that a smile of incredulity extended over the faces of some stock-breeders when such inquiries were put to them, and they feared they were to be made the victims of a "sell." No instances of the alleged "reversion" having been authenticated in Prof. Brewer's experience, he asked the Association to aid in exposing and refuting the pernicious notion.

REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL"*

VII.—*Skull of the Snake* (Coluber natrix).

AMONG the most noticeable features of the Ophidian skull may be mentioned the ivory-like texture of the bones, the immense strength and compactness of the brain-case, and the equally remarkable mobility of the facial bones, the maxillary and palatine apparatuses and the lower jaw being arranged in such a way as to allow of the greatest possible extension of the mouth during deglutition. Another important characteristic is the bony completeness of the brain-case, which is as thoroughly closed in as that of a mammal, scarcely any part of its walls being formed in the adult either by cartilage or fibrous tissue; the inter-orbital septum, also, or laterally compressed anterior moiety of the basis cranii, so characteristic of the Sauropsida, is absent, the base of the skull being flat throughout, and abruptly terminated in front. But the most interesting and at the same time most anomalous feature is the persistence of the fœtal trabeculæ, in the form of two slender cartilaginous rods (Fig. 23, Tr), lying in grooves on either side of the parasphenoid.

The hinder part of the skull is formed by a well-ossified occipital segment, the four elements of which are firmly united with one another by suture; the single convex occipital condyle is borne chiefly by the basi-occipital, the exoccipital, however, taking a considerable share in its formation. The basi-occipital is continued forward by a broad, expanded, basi-sphenoid, produced anteriorly into a slender prolongation or rostrum (Fig. 22, Pa.S), which underlies the front half of the brain-case, and answers to the parasphenoid bone.

The parietals are completely fused together in the mid-line, where they are produced in the Pythons and Boas into a strong sagittal crest for the attachment of the temporal muscles. In their hinder half they are simply roofing bones, as in Lizards and Amphibia; but in front of the auditory capsule they extend downwards (Fig. 23, Pa^1) and meet the parasphenoid, forming with it a complete cylindrical cavity. The frontals, unlike the parietals, have only a sutural union with one another; but they, too, are produced downwards (Fr′), and, moreover, come into contact with one another below, above the parasphenoid, so as to form unaided the whole of the anterior third of the brain-case—roof, walls, and floor. There is yet another important feature in these curious bones—the cylindrical cavity which they enclose is divided in front by a double pillar of bone, to which each frontal contributes its own half, and on either side of which the olfactory nerves pass to the nasal sacs: in this way a remarkable resemblance, both in form and position, to the frog's "girdle-bone" is produced; an analogy, indeed, which only the study of development can show to be as far as possible from a true homology.

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* Continued from p 250.

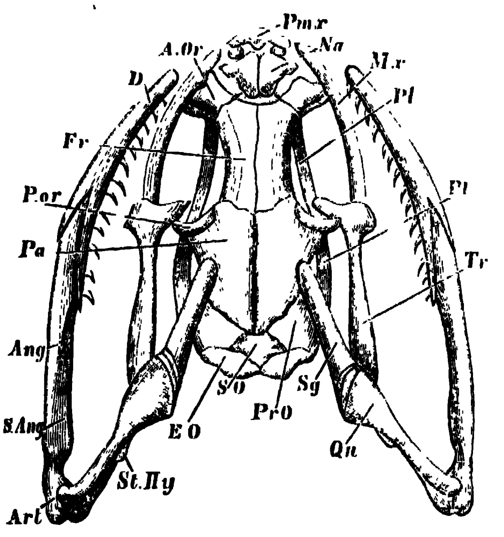

FIG. 21.—Skull of Snake (upper view). Tr, Os transversum

Interposed between the anterior border of the ex-occipital and the posterior border of the descending portion of the parietal, is a stout irregular bone, which anyone studying the adult skull only would certainly look upon as the periotic or ossified otic capsule. As a matter of fact, however, it is both more and less than this. In the young state it consists of two perfectly distinct ossifications, between which the fifth nerve makes its exit. Now, this nerve (see NATURE, vol. x., p. 10) marks the line of demarcation between the posterior boundary of the parietal segment and the auditory capsule; the bone in front of it is, therefore, the alisphenoid, and that behind it the prootic, the latter being further determined by the fact that it lodges the main part of the vestibule, of the anterior and horizontal canals, and of the rudimentary cochlea. The remaining elements of the ear-capsule are, in the adult, quite undistinguishable; it is seen, however, that the arch of the posterior canal, as far forward as its junction with the anterior, extends into what appears to be the supra-occipital, and that the ampulla of the posterior and the hinder portion of the horizontal canals invade, in like manner, the ex-occipital. The explanation of this seeming anomaly—so common in the Sauropsida—is to be found in the snake at the time of hatching, when the pro-, epi-, and opisthotic elements are perfectly distinct from the neighbouring bones as well as from one another: as growth proceeds the epiotic becomes firmly anchylosed with the supra-occipital, and the opisthotic with the ex-occipital: the prootic, at the same time, remaining separate from the bones with which it is naturally related, acquires an intimate connection with the alisphenoid, forming with it the seeming "periotic" of the adult snake.

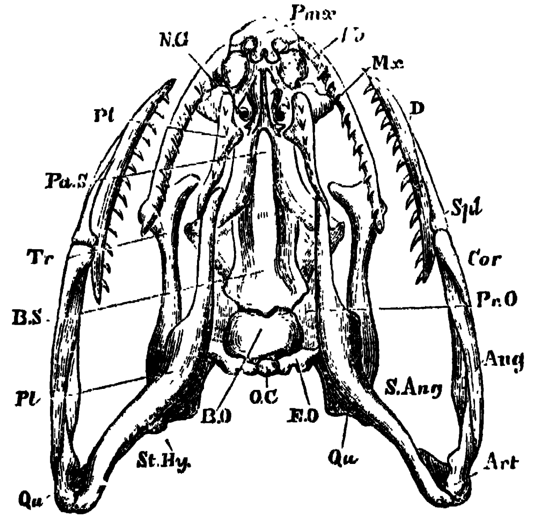

FIG. 22.—Skull of Snake (under view). Spl, splenial; Cor, coronary; Ang, angular; S.Ang, supra-angular.

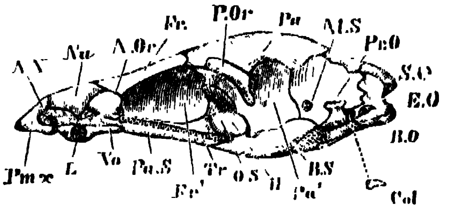

FIG. 23.—Skull of Snake (side view, with jaws removed). Col, columella, displaced from the fenestra ovalis, with which it is connected by a dotted line.

At the sides of the frontal region, and forming the anterior and posterior boundaries of the orbit, are two representatives of the "lateral line series" so prominent in osseous fish: these are the antorbital and the post-orbital. The antorbitals are large triangular bones, and between them lie the nasals, which together have a rhomboid form, and the inner edges of which are turned downwards, forming vertical plates similar to the inter-olfactory pillars of the frontals. In front of the nasals, and forming the termination of the snout, is the small toothless premaxilla, an azygos bone, with short nasal, maxillary, and palatine processes. The vomers are two hollow, scroll-shaped bones, bearing on their excavated upper surfaces the nasal glands; the ducts of these pass through a notch in the outer border of the vomers, which is converted into a foramen by means of a triangular ossification, the septo-maxillary, here attaining its greatest development. The duct of the nasal gland is also supported on the outer side by two labial cartilages (l).

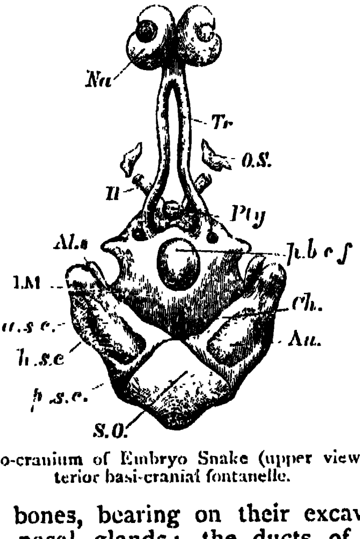

FIG. 24.—Chondro-cranium of Embryo Snake (upper view). p.b.c f, posterior basi-cranial fontanelle.

The foregoing bones are all compactly united with one another; the remaining ones, forming the powerful manducatory apparatus of the upper and lower jaws, are articulated only by loose fibrous tissues, and are thus rendered capable of the greatest possible amount of extension.

On the upper surface of the skull, clamping the lateral occipital region and projecting backwards for fully half its length beyond the latter, is the flat sabre-like squamosal (Fig. 21, Sq), articulated to the hinder end of which, and thus carried completely away from the auditory region, is the quadrate, a stout bone passing obliquely downwards and outwards, and giving attachment by a rounded pulley-like surface to the mandible. On the inner edge of the quadrate, and partly coalesced with it, is a small nodular ossification representing the stylo-hyal (Figs. 21 and 22, St.Hy). The palatines and pterygoids are well developed and bear large recurved teeth; the latter extend backwards to the quadrate, to which they are united by ligaments just above its articular surface. The maxillæ are large strong bones lying parallel with the palatines and the front half of the pterygoids, and forming an outer dentigerous arch. Between the hinder end of the maxilla and the centre of the pterygoid runs a stout bone, the os transversum, found in this distinct form in all Ophidia, as well as in Lacertilia and Crocodilia, and occurring as a rudiment in some birds.

The two rami of the mandible are united at the symphysis by elastic fibrous tissue only, and each consists of six separate ossifications more or less fused together in the adult. These are the articular (Art) coming into relation with the quadrate, the angular (Ang) and supra-angular (S. Ang) applied, one above and one below, to the outer surface of the articular, the dentary (D) bearing the teeth, and the splenial (Spl) and coronary (Cor) appearing only on the inner surface.

The columella or auditory ossicle is extremely small in the common snake (Fig. 23, Col), and consists of a plug of bone fitting into the fenestra ovalis by a rounded disc-like end, the stapes, and of an extremely short rod anchylosed with and projecting backwards from the disc, which is all that represents the stapedial bones of the frog. In many of the larger serpents, both venomous and harmless, the columella is a rod of very considerable length, tipped at its end, in some cases, by an expanded cartilaginous flap, the homologue of the extra-stapedial.

The earlier stages in the development of the snake's skull have been well worked out by Rathke (" Entwickelungsgeschichte der Natter "). Abstracts of his views will be found in Prof. Huxley's Croonian Lecture (Proc. Roy. Soc., 1858), and in the " Elements of Comparative Anatomy " of the same author (p. 237). The earliest stage described by the lecturer corresponds with Rathke's third period, when chondrification is already thoroughly established, and the slender trabeculæ have united behind with the investing mass, and in front with each other (see Fig. 24). The notochord (Ch) reaches only to the middle of the broad investing mass (I.M), a large membranous space, the "posterior basi-cranial fontanelle" of Rathke (p.b.c.f) being between its anterior pointed end and the " anterior basi-cranial fontanelle," or pituitary space. A large occipital ring is already formed by the growing up of the investing mass around and above the neural canal, and articulating with its edges are the sub-triangular auditory capsules, on which the elevations caused by the semicircular canals (a.s.c, p.s.c, h.s.c) are particularly well marked. The trabeculæ diverge strongly in the pituitary region, in front of it run almost parallel, having between them the tissue from which the parasphenoid is afterwards formed, and eventually unite and expand into the large reniform roofs of the nasal sacs (Na). The alisphenoids (Al.s) are already chondrified, but the orbito-sphenoids (O.s) are backward in development, being mere patches of indifferent tissue in front of the exit of the optic nerve (II). The mandibular arch is completely divided into a short quadrate and a long Meckel's cartilage. The hyoid arch is cartilaginous only in its upper part, and its apex is already fused with the stapes.

In the second stage all the bones of the adult have appeared with the exception of the alisphenoid, orbito-sphenoid, columella, stylo-hyal, and otic bones. The basi-occipital arises in the same manner as the urostyle of a frog or osseous fish,* as a bony deposit in the sheath of the notochord, affecting subsequently the surrounding cartilage; the basi-sphenoid makes its appearance as a pair of ossific centres, one on each side of the apices of the trabeculæ, where they join the investing mass. The parietals and frontals are quite normal in their development, arising as symmetrical ossifications in the supero-lateral region of the membranous cranium, and only acquiring their anomalous adult character by downward extension towards the base of the skull at a later period. In this stage a segment has separated from the hyoid arch and attached itself to the inner border of the quadrate: this is the stylo-hyal, the remainder of the arch now constituting the columella.

In the third stage, consisting of snakes at the point of hatching, all the ossifications have appeared, with the exception of the orbito-sphenoid, which is unusually late and uncertain in its development. Besides the three chief otic centres, which are perfectly distinct from the occipital regions, a plate of bone is to be seen in this stage within the lower edge of the squamosal: this answers to the ectosteal plate of the pterotic, so largely developed in osseous fishes. Lastly, the jaws have acquired their adult character by the loosening of the quadrate from the auditory capsule and its retrogression to its adult position, articulating with the hinder end of the backward-turned squamosal.

NOTES

A MOVEMENT which has been for some time on foot for establishing in London a School of Medicine for Women is now so far matured that the school will be opened for the winter term on Oct. 12, in commodious premises, 30, Henrietta Street, Brunswick Square. The full staff of lecturers has not yet been appointed, but among those who have already consented to take part in the instruction are Dr. King Chambers in the practice of Medicine, Mr. Berkeley Hill in Surgery, Mr. A. T. Norton in Anatomy, Dr. Sturges in Materia Medica, Mrs. Garrett Anderson in Midwifery, Mr. Critchett in Ophthalmic Surgery, Dr. Cheadle in Pathology, Mr. Heaton in Chemistry, and Mr. A. W. Bennett in Botany. The following gentlemen have, in addition, consented to serve on the Council:— Dr. Billing, Dr. Buchanan, Mr. Ernest Hart, Prof. Huxley, Dr. Hughlings Jackson, Dr. Murie, Dr. F. Payne, Dr. W. S. Playfair, and Dr. Burdon-Sanderson, as well as Dr. Elizabeth Blackwell. A fair number of students are already enrolled. It is intended to build a detached dissecting-room in the garden attached to the house.

DR. WILLIAM RUTHERFORD has been appointed to the Professorship of Physiology at the University of Edinburgh, vacated by the resignation of Dr. J. Hughes Bennett. Dr. Rutherford, in accepting his new appointment, vacates the Professorship of Physiology at King's College, London, the Assistant-Physicianship at King's College Hospital, and the Fullerian Professorship at the Royal Institution. The duties of the first of these will most probably be undertaken, during the coming session at least, by Dr. David Ferrier.

DR. ADOLF BERNHARD MEYER, the recent explorer of New Guinea, has been appointed director of the Zoological Museum at Dresden, in succession to Dr. Reichenbach, who has retired.

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* In these types a variable number of vertebræ at the termination of the column undergo a process of absorption, and a single ossification appearing in the sheath of the notochord constitutes the urostyle or coccyx. In the head a similar process takes place at the anterior end of the notochord, where a number of vertebræ may be considered to have been suppressed, forming what may be termed a " cephalostyle": the bony deposit spreading from this into the investing mass, gives rise to the basi-occipital.

Dr. Meyer entered upon his new duties on the first of last month.

A CORRESPONDENT with the Transit of Venus Expedition to Honolulu, writing from Valparaiso, informs us of the safe arrival there of the party after a particularly fine passage south; the weather was not so favourable up the Chili coast.

A LARGE and influential meeting of the professional and private friends of the late Dr. Anstie was held on the 23rd ultimo, at the house of Dr. George Johnson, in Savile Row, for the purpose of taking steps to raise a fund to be applied in perpetuation of Dr. Anstie's memory, and in recognition of his public and professional services. Dr. Burdon-Sanderson moved, and Dr. Glover seconded, a resolution—"That, considering the labours of the late Dr. Anstie for the promotion of science, and the circumstances of his untimely death, it is desirable that some permanent memorial of his career should be established." In speaking to this resolution, it was pointed out that Dr. Anstie's widow and three young children were but slenderly provided for, and hence that his only son would probably be unable to obtain the complete education which his father, if his life had been spared, had intended to secure for him. It was felt that the proposed memorial might fittingly take the form of a fund to be devoted to this object, and it was hoped that such an application of money might not be unacceptable to his family, and might be received by them as a fitting tribute to the estimation in which Dr. Anstie was held. By subsequent resolutions, a large committee was appointed to carry out the objects of the meeting, and Mr. J. S. Storr, of 26 King Street, Covent Garden, was appointed treasurer, and Mr. Brudenell Carter and Dr. Wharton Hood were appointed joint honorary secretaries. An executive committee was also nominated; and an opinion was expressed that the circumstances of Dr. Anstie's death, in the discharge of his duty, as well as much of the work which he had done during life to ameliorate the condition of the poor, were sufficient to justify an appeal to the general public as well as to his own profession.

THE Photographic Society invites scientific men who have turned their attention to photography to furnish specimens for their forthcoming exhibition. It is proposed to devote a room to the purely scientific applications of the subject.

WE would again draw the attention of secretaries of British scientific societies to the proposed work referred to in a recent number (NATURE, vol. x. p. 407) by M. Raus, of the Belgian Academy—a Dictionary of Learned Societies. He is of course anxious to get full and trustworthy information, and we hope that the numerous societies of this country will lend him every assistance in carrying out his valuable scheme.

THE news of the death of M. Elie de Beaumont, in his 76th year, has thrown a gloom over the French Academy. We believe that his position of perpetual secretary to the Academy will be conferred on M. Bertrand, at present president of the Academy of Sciences. The *fauteuil* of M. Bertrand, who is a member in the section of Geometry, would thus become vacant, and would be the object of a warm contest. Since the foundation of the Academy of Sciences, the place of secretary has been permanent, while that of president has been annual. Among the predecessors of M. de Beaumont were Fontenelle, who died a centenarian after having occupied his *fauteuil* for sixty years, Condorcet, Fourrier, Delambre, and Arago, whom De Beaumont succeeded, the two together having held office for more than half a century. Since the death of Flourens, M. Dumas has been secretary for the Physical Sciences.

AT the Aberdeen Cryptogamic show referred to in last week's NATURE, p. 427, a meeting of botanists was held, when it was agreed to form a Scottish Cryptogamic Society, which, by an annual exhibition held in the larger cities by rotation, and by other means, would endeavour to promote a more general and deeper knowledge of cryptogamic plants. It is intended to hold the exhibition for next year at Perth.

THE first session of the Yorkshire College of Science, Leeds, opens on the 26th inst. There are already four professorships—Mathematics and Experimental Physics (Prof. Rücker), Chemistry (Prof. Thorpe), Geology and Mining (Prof. Green), Textile Fabrics (Prof. Walker).

THE expedition organised in June last by Captain Williams, of Sunderland, in the steamship *Diana*, belonging to Mr. Lamont, of Dundee, has returned to the latter port. The Novaya Zemlya region was the scene of the *Diana's* cruising; the Gulf of Obi was reached, and the conclusion come to that without difficulty a vessel might make Behring Strait. Capt. Wiggins, who was in command, endeavoured to assist the Austrian expedition, but was compelled to give up the attempt. Curiously, however, the *Dinaa* reached Hammerfest just an hour before the members of the Austrian expedition. Some important corrections of the geography of the region around the mouth of the Obi have been made.

THE council of the Institution of Civil Engineers have issued a list of subjects for premiums to be awarded during session 1874-75. Information with regard to the premiums, which are valuable, is prefixed to the list, and we advise those interested to apply to the secretary for information.

THE Council of the Institution of Naval Architects have had under consideration the question of providing a good series of contributions for their next session. They have accordingly prepared a list of subjects, which they desire to submit to the members and associates of the Institution, and others interested in shipbuilding, as questions on which they will be glad to receive communications for the annual general meeting in March (17th to 20th), 1875. Anyone wishing a list of the subjects should apply to the Secretary, 20, John Street, Adelphi.

THERE are several reports to hand of recent earthquakes. There was a violent shock at Randazza, Sicily, on Sept. 27, and several houses were injured. Rumbling noises are audible from Mount Etna.—Intelligence published at New York on Sept. 26 reports that the town of Antigua, in Guatemala, has been destroyed by an earthquake.—Several shocks of earthquake were felt at Delhi on Aug. 31, at 5.25 A.M.—A shock was felt near Sucklaspore, in the Madras Presidency, on the evening of the 17th Aug. The direction of the shock was from east to west, and the duration seven seconds.

A TERRIBLY destructive typhoon swept over Hong Kong about 12 o'clock on the night of Sept. 23. Many vessels were wrecked and the loss of life is estimated at 1,000, and the damage done to property is immense. The typhoon reached Macao, causing there also a fearful amount of damage.

ONE of the Limuli at the Crystal Palace Aquarium died last week from the effects of the continued attacks made on it by lobsters in the same tank. The other Limuli are now in a separate tank.

THE Swiss Society of Public Usefulness, says the *Continental Herald*, which met at Friburg from the 21st to the 23rd inst. inclusive, treated the subjects engaging its attention under two heads, viz., Public Instruction and Industry. Under the first head it discussed whether the professional teaching now given in the Confederacy should be altered; whether in the secondary schools for boys a larger share of scientific education ought not to be given, combined with practical exemplification, manual labour, and experience in industrial chemistry; whether in the secondary and superior schools for girls sufficient attention is paid to the class of studies which will be of service in careers now open to women, and if their education is directed towards facilitating their entry into new occupations; whether it would not be advisable to introduce into secondary schools for girls commercial education and the study of drawing as applied to manufactures, such as those of ribbons, lace, printed stuffs, wall papers, &c.

A NEW horticultural garden has been opened at St. Petersburg under Imperial patronage. It is fifteen acres in extent, and is to be devoted principally to illustrate how native plants may be combined for pretty and tasteful decorations. One large portion is to be devoted to conifers, in order that there may be, even in winter, green promenades.

THE consumption of osiers for various purposes, in England especially, is very great. Besides her own production, this country imports more than 5,000 tons, valued at about 40,000*l.* About 300 varieties of osiers are known, the most important beds being situated near Nottingham; the home produce being insufficient to meet the demands, great attention is being paid to the cultivation beds in Australia, and a considerable quantity is yearly produced in that country.

THE cultivation of the Angora Goat is attracting some attention in Australia, where this animal appears to thrive very well. The hair is said to make a very good "mohair" fabric, but its quality depends very much upon the nature of the locality in which the animals are reared. Undulating prairies with a good supply of pure water are best adapted to the habits of this goat. In sandy hilly districts it thrives admirably, but the hair is inferior and falls off very quickly. The flesh is excellent, and is preferred in some parts of Australia to the best mutton. The milk is of good quality and yields a good supply of butter and cheese. The hair is worth about four shillings a pound, and one ram will yield about four pounds at each shearing; the best plan is to shear them twice a year, as this prevents the hair from falling off and from splitting; at each shearing it is about six inches long. Compared with the merino sheep, the Angora goat seems to have the advantage in the fact that the former produces only three-and-a-half pounds of wool, worth two shillings and sixpence per pound, and that six merinos will eat as much as seven Angoras. These facts are important in view of the acclimatisation of the Angora goat in other parts of the world.

THE New Zealand Flax (*Phormium tenax*) is being cultivated in St. Helena, and there seems no reason why the same thing should not be done in other countries. Hitherto no very great attention has been paid to the cultivation of this plant, but the natural supplies obtained in New Zealand are insufficient for the demands of commerce. It is a mistake to suppose that an illimitable supply can always be obtained because no cultivation has been necessary in the first crops of the wild produce. This is not to be regretted, for careful cultivation cannot fail to greatly improve the fibre, and the best kinds alone will be worth the trouble of proper rearing. Steps are however being taken to cultivate the plant in New Zealand and in other countries which have been fortunate enough to acclimatise it. In the Azores, at St. Helena, in Algiers, and the south of France, it thrives well, and has been easily naturalised. The fibre is principally used for making ropes and paper, for the caulking of vessels, for stuffing mattresses, and for coarse textile fabrics. The seeds yield a valuable oil when crushed.

THE Crystal Palace Company are to give a magnificent fête on behalf of the Hospital Saturday Fund on the 5th inst.

M. HENRY COCKERILL, of Aix-la-Chapelle, nephew of the late John Cockerill, we learn from the *Journal of the Society of Arts*, who founded the great engineering establishment at Seraing, near Liege, which until the immense extension of the Creuzot works was the largest on the Continent, has placed at the disposition of the Société Cockerill the sum of 50,000 francs, to be invested in the public funds of Belgium, the interest to be applied to the endowment of scholarships, to enable the sons of workmen, or others employed by the society, to attend the courses of study at the Mining School of Liege.

THE popular demand in America for a complete series of the annual reports of the United States Geological Survey of the Territories, under the charge of Dr. F. V. Hayden, has been so great that the Secretary of the Interior has ordered the printing of a second edition of the first three annual reports in one volume. A compact 8vo. of 261 pp. with index has in consequence been issued. The survey in its present form commenced in the spring of 1867 with the small grant of $5,000 for the survey of Nebraska, and the following year a similar grant was made for Wyoming. During these two years the survey was under the General Land Office, and the first and second annual reports were included in the reports of the commissioner. Their reprint is a great convenience for reference. In the third year (1869) the survey was placed by Congress under the Secretary of the Interior, and $10,000 was granted for the examination of Colorado and New Mexico. The volume for that year was issued as an independent volume, and was reviewed in NATURE, vol. iv. p. 24. These reports differ from the memoirs of our English survey, which are in illustration of single sheets or sometimes quarter sheets of maps of the survey, for a United States Report includes a whole State. Our own enter into detail; these give general views. Further, these reports give not only the geological and palæontological features and mineral resources of a State, but its agricultural condition and prospects are included. Speaking of the treeless prairies, Dr. Hayden expresses his belief that forests may be restored in a short time, and gives many illustrations of what planters have effected in ten years in Nebraska. Cotton-wood (*Populus monilifera*), Soft Maple (*Acer rubrum*), Elm (*Ulmus americana*), Bass-wood or Linden (*Tilia americana*), Black Walnut (*Juglans nigra*), Honey Locust (*Gleditschia tricanthus*), and Willows, are the trees mostly cultivated. English agriculturists may perhaps be astonished at hearing crops being spoken of as promising because the grasshoppers have left a full half crop of wheat. In the first report are some interesting notes on the present condition of the Otoe Indians; and notes by Dr. Newberry and Prof. Heer, on the fossil leaves of the Dokata group; while the second report includes a sketch of the physical geography of the Missouri Valley. Although called a geological survey, climatal and meteorological observations are interspersed, as well as much information about game and wild animals. There is also much valuable agricultural information, that alone would create a large demand for the reprint.

WE have received the Eighth Annual Report of the Aëronautical Society. The report is mainly occupied with an account of experiments and calculations which have been recently made, and contains a paper by Mr. D. S. Brown on the Aëroplane, and a long and elaborate paper by Mr. James Armour, C.E., entitled "Wings for Man."

THE additions to the Zoological Society's Gardens during the past week include a Praslin Parrakeet (*Coracopsis barklyi*) and four Red-crowned Pigeons (*Erythrœnas pulcherrima*) from the Seychelles, presented by the Hon. Sir Arthur Gordon; two Burchell's Bustards (*Eupodotis kori*) from S. Africa; a Hocheur Monkey (*Cercopithecus nictitans*) from W. Africa; a Punjaub Wild Sheep (*Ovis cycloceros*) from N. W. India; two Blackish Sternotheres (*Sternothœrus subniger*) from the Seychelles; a Common Octopus (*Octopus vulgaris*) from the British Seas, deposited.

THE BRITISH ASSOCIATION

REPORTS

Tabular View of the Classification of the Labyrinthodonta, by L. C. Miall. Summary of the Second Report on Labyrinthodonta.

AMPHIBIA

LABYRINTHODONTA.

A.—*Centra of dorsal vertebræ discoidal.*[1]—Genera 1 to 25.

I.—EUGLYPTA. Cranial bones strongly sculptured. Lyra conspicuous. Mandible with well-developed post-articular process. Teeth conical; their internal structure complex; dentine much folded. Palato-vomerine tusks in series with small teeth. Short inner series of mandibular teeth. Sculptured thoracic plates, with reflected process upon the external border.

* *Palatine foramina large, approximated.*
† *Mandible with an internal articular buttress.*
‡ *Orbits central or posterior*
1. Mastodonsaurus, Jager.
2. Capitosaurus, Munst.
3. Pachygonia, Huxley (?).
4. Eurosaurus, D'Eichwald (?).
5. Trematosaurus, Braun.
6. Gonioglyptus, Huxley.

‡ ‡ *Orbits anterior.*
7. Metopias, Von Meyer.
8. Labyrinthodon, Owen.[2]

† † *Mandible without internal articular buttress.*
9. Diadetognathus, Miall.

* * *Palatine foramina small, distant.*
10. Dasyceps, Huxley.
11. Anthracosaurus, Huxley.

II.—BRACHYOPIDA. Skull parabolic. Orbits oval, central or anterior. Post-articular process of mandible wanting (?).
12. Brachyops, Owen.
13. Micropholis, Huxley.
14. Rhinosaurus, Waldheim.
15. Bothriceps, Huxley.

III.—MALACOCYLA. Skull vaulted, triangular, with large postero-lateral expansions. Lyra consisting of two nearly straight longitudinal grooves, continued backwards as ridges. Orbits large, posterior, irregular. Temporal depressions, passing backwards from orbits. No post-articular process to mandible.[3]

* *Teeth with large anterior and posterior cutting edges.*
16. Loxomma, Huxley.

* * *Teeth conical.*
17. Zygosaurus, D'Eichwald.

IV.—ATHROODONTA. Maxillary teeth wanting. Vomerine teeth aggregated. Orbit imperfect.
18. Batrachiderpeton, Hancock and Atthey.
19. Pteroplax, Hancock and Atthey.[4]

[V.—An uncharacterised group for the reception of some or all of the following genera.]
20. Pholidogaster, Huxley.
21. Ichthyerpeton, Huxley.
22. Pholiderpeton, Huxley.
23. Erpetocephalus, Huxley.

VI.—ARCHEGOSAURIA. *Von Meyer.* Vertebral column notochordal. Occipital condyles unossified.
24. Archegosaurus, Goldfuss.
25. Apateon,[5] Von Meyer.

B.—*Centra of dorsal vertebra elongate, contracted in the middle.*

VII.—HELEOTHREPTA. Skull triangular, with produced, tapering snout. Orbits central. Mandibular symphysis very long, about one-third of the length of the skull.
26. Lepterpeton, Huxley.

VIII.—NECTRIDEA. Epiotic cornua much produced. Superior and inferior processes of caudal vertebræ dilated at the extremities and pectinate.
27. Urocordylus, Huxley.
28. Keraterpeton, Huxley.

IX.—AISTOPODA. Limbs wanting.
29. Ophiderpeton, Huxley.
30. Dolichosoma, Huxley.

X.—MICROSAURIA, *Dawson.* Thoracic plates unknown. Ossification of limb-bones incomplete. Dentine non-plicate, pulp cavity large.
31. Dendrerpeton, Owen.
32. Hylonomus, Dawson.
33. Hylerpeton, Owen.

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[1] This character is not of primary importance, but seems to be available for an arrangement determined by other considerations.

[2] Orbits unknown.

[3] Loxomma.

[4] The vomerine teeth are unknown, and this genus may therefore require to be removed.

[5] Of doubtful distinctness.

SECTIONAL PROCEEDINGS

SECTION A—MATHEMATICS

On the Photographic Operations connected with the coming Transit of Venus, by Captain Abney, R.E., F.R.A.S.

As is doubtless well known to all, there will be an application of photography to register the passage of Venus across the sun's disc, and it may not be amiss to give an outline of the processes, &c., that will be adopted. It has been determined by the Astronomer Royal that at every photographic station a photograph shall be taken every two minutes during the transit, and it has been a matter of considerable labour to work out a process that will admit of such a large number of negatives being taken in a hot climate. In Kerguelen's Land it would be perfectly feasible to adopt the ordinary wet process, the low temperature admitting of it, but in a temperature of 90° F. the evaporation of the volatile constituents of the collodion would render such a procedure inapplicable, as all practical photographers will admit. In India, where I have worked extensively, coating two or three plates in succession in a large-sized tent has sometimes proved injurious. With such experience I venture to think that it would have been madness to trust to the wet method for four hours, unless the conditions of *personnel* of the parties were considerably altered. Sir G. Airy, after much anxious deliberation, and with the advice (and that not hastily formed, by any means) of Mr. De la Rue, determined to adopt a dry process if practicable. After considerable experiments conducted at Chatham, it was determined to adopt an albumen dry process, using a highly bromised collodion, and strong alkaline development. There were several advantages in this:—(1) At the critical time the photographers would have nothing to distract their attention excepting placing the dry plates in the slide and developing every twelfth plate exposed, in order to regulate the exposure; (2) the irradiation was much diminished by the use of albumen, a point of no small importance when measurements have to be taken; (3) the shrinkage of the film is reduced to zero when the plates are properly prepared.

In regard to the first advantage claimed, it will be apparent that plates prepared at leisure will have a much superior advantage to those prepared in the hurry of the moment as would be the case with wet plates. The chances of stains and spots are diminished tenfold, and we may expect a much clearer picture.

The true explanation of irradiation has been argued of late in NATURE, and perhaps I may be pardoned for dwelling an instant on that point. Irradiation may be divided into two kinds, viz., that occurring from reflection from the back of the plate, and that occurring from reflection from the particles of bromide or iodide of silver in the collodion film. The first requires no explanation. If a film be insufficiently dense and of such a colour as will cut off the most active rays of the spectrum, no irradiation on that account need be anticipated. Iodide of silver fulfils this condition much more fully than does bromide of silver, the former approaching to a yellow colour, whilst the latter is almost white. A thin layer of iodide is much more efficient in cutting off the blue end of the spectrum than is the bromide; hence, if irradiation through reflection from the back of the plate is to be overcome, it is wise to use a certain proportion of iodide in the collodion. Practically I have found that in the dry process under consideration, three parts of iodide to two of bromide give the best results without diminishing the sensitiveness of the film. The second cause of irradiation, viz., reflection from the particles of bromide and iodide, is not hard to explain. When a colloid body such as gelatine or albumen is brought in contact with a soluble salt of silver, the resisting compound is found to be one which is singularly free from this defect. If a ray of light be allowed to fall at right angles upon a very thin cell containing an emulsion of bromide of silver, the cell having worked glass sides and ends, it will be found that the ray of light will be scattered considerably, apparently in a logarithmic curve; the surface nearest the source of light will not be affected, but it will spread from that surface towards the other, a physical line of light becoming an area. If, however, a colloidal salt of silver be introduced it will be found that this area is much diminished, and for small distances becomes inappreciable. In connection with this I may mention that bromide plates, even when backed with a non-actinic backing in optical contact with the plate, will give irradiation with alkaline development, whilst with acid development the irradiation will disappear. The explanation is not far to seek—the alkaline development reduces the silver *in situ*, the acid development deposits silver on the surface and where there is most attractive force. In the former case, the dispersed light acting on the interior of the film, causes the necessary change in the bromide of silver to effect reduction. Daguerreotype plates are not free from irradiation as has been supposed, though, owing to the extraordinary thinness of the iodide of silver, but little effect can be traced unless very prolonged exposure be given.

In the dry process selected for the transit of Venus it has then been thought desirable to have a rather dense film containing a proportion of iodide of silver and a colloid body—albumen—as preservative. I am not unmindful of the fact that different pyroxylines more or less affect irradiation, and we have altered the constitution of the pyroxyline in the collodion I shall use, by adding certain proportions of water; this materially aids the annihilation of irradiation from these plates.

For registering the time of external and internal contact of the planet with the sun's disc, the method known as Janssen's has been adopted, viz., causing a fresh portion of a plate to be exposed every second during the critical time, to the sun's limb, at that part where the contact will take place. Mr. Christie and Mr. De la Rue have both devised a slide for this purpose. The English parties use that designed by the former, whilst Colonel Tennant will use that by the latter. Shrinkage in the film has been carefully looked for by Dr. Vogel, of Berlin, and also by myself. Photographing a grating of 200 lines to the inch by contact printing, and measuring the results, I have been unable to find any alteration in the distances of the lines at any part of the film, hence I feel confident that any shrinking that can take place will be so small as to be negligible. The Russian parties are, I believe, going to use a grating material of iron wires. If shrinkage does occur this would be necessary, but it seems almost useless, in fact hurtful, where there will be none. There must be a certain error introduced due to the grating itself. The method of finding the angle of the position of the wires will be determined photographically. Two pictures of the sun will be taken at an interval of one minute on the same plate. The line forming the intersection of the sun's images will give the angle of position of the wires when measured by the micrometer. At each station the photographic party will consist of one officer and three sappers, all of whom have been trained in the use of the photo-heliograph and the process employed. A drill for each operation has been devised, and it is anticipated that the dangers of excitement during the critical times have been overcome by this arrangement. Practice on a mock transit has ensured a thorough knowledge of each phase of the phenomena; and I apprehend that discipline combined with a trust in their superiors will have annihilated one source of failure.

On the importance of improved methods of Registration of Wind on the Coast, with a notice of an Anemometer, designed by Mr. W. De la Rue, F.R.S., to furnish telegraphic information of the occurrence of strong winds, by Robert H. Scott, M.A., F.R.S.

It is hardly necessary to draw the attention of the Section to the fact that the configuration of the earth's surface exercises an overwhelming influence on the wind both as to its direction and force. Some statements and tables contained in a paper of mine in the last number of the *Quarterly Journal* of the Meteorological Society [*] abundantly prove this assertion, and it is therefore easy to see what an imperfect representation of the actual force of the wind at sea can be furnished by reports from a broken and mountainous coast, such as the Atlantic coasts of Ireland and Scotland, where the telegraphic stations are perforce situated in sheltered places, inasmuch as harbours are naturally found where there is as little exposure to wind as is possible.

In the practice of weather telegraphy and storm warnings, as the number of reports received per day from each station is strictly limited, on financial considerations, it is quite obvious that if the actual epoch of the commencement of a gale does not fall within the hours of attendance at the Telegraphic Office and at the Meteorological Office, which practically only extend from 8 A.M. till 3 P.M., much time will be lost in sending news of the fact to London. If it commences at 6 P.M. at Valencia, we cannot hear of it in London till 9 A.M. next morning.

On the other hand, if the observer be living in a sheltered spot, such as Plymouth, Nairn, or Greencastle, we shall not get a true report of the gale at all, inasmuch as the observer will not have felt it himself.

The first-named defect in our system can only be met by a considerably increased expenditure on the service, and that is not a scientific, but an administrative question, with which the Government can alone deal.

In order to meet the second difficulty, Mr. De la Rue has kindly devised an instrumental arrangement, by which the fact of any given force of wind having been reached at an exposed point (such as Rame Head for Plymouth, or Malin Head for Greencastle), can be at once conveyed to the reporter in his own office, or even to the central office in London. The instrument has been made by Messrs. Negretti and Zambra.

The following is the construction of the new signalling anemometer.

To the ordinary Robinson's anemometer spindle is affixed a toothed wheel, which is geared with another and larger toothed wheel fixed on a second vertical spindle which carries a centrifugal governor. The governor spindle is made to rotate at one-half or one-third of the velocity of the anemometer spindle in order that the rods carrying the governor balls may not have to be made inconveniently short. A provision is made for adjusting the length of the arms of the governors so that different wind velocities may be indicated within certain limits.

The governor balls act in the well-known way and expand when driven at a given rate, and the upward motion of these governor balls is used to raise a secondary wheel to bring into gear a third spindle on which is fixed the armature of a magneto-electric apparatus, which, like Sir Charles Wheatstone's instruments, consists of a compound permanent magnet with four soft iron cores, two of which are mounted on the north pole of the magnet and two on the south pole; these iron cores are surrounded with fine insulated copper wire, and on rotation of the armature give alternate + and − currents, in rapid succession according to the rate at which the armature is driven. These currents are conveyed inland to the observing station by insulated wires, and give warning by ringing an alarum as long as the anemometer cups are revolving at a velocity sufficient to raise the governor balls so as to bring the magneto-electrical apparatus into gear.

We see, therefore, that by adjusting the governors of the apparatus to indicate any required speed, a warning will at once be given when the wind reaches that speed, be it that of 60, 40, or 20 miles an hour, as may be required.

All the attention which the instrument requires after the apparatus is fixed is to lead two insulated wires from the anemometer into the observing station, and to connect these wires to the two terminals on the alarum.

In order to enable the observer to communicate at once and at as little expense as possible, to London, the fact of the velocity in question having been reached, the individual stations might be known by letters or symbols which might simply be telegraphed to London as an announcement that the alarum was acting at the station in question.

It is obvious that this plan is exceedingly simple, and there seems little reason why it should not be thoroughly efficacious, if only the registering portion of the apparatus can be properly protected from wilful damage by mischievous persons.

As usual, we are met by the question of cost, not only of the apparatus but of the connecting wires, and last, though not least, of the transmission of the messages. To enable us to render our service more effective than it is we must be supplied with the sinews of war. The 3,000*l.* which is the very utmost we spend annually on telegraphy, including salaries, rent, and every item, is but small compared with the 50,000*l.* *entirely exclusive of salaries* with which the chief signal office of the United States is so munificently endowed.

On the Source from which the Kinetic Energy is drawn which passes into Heat in the Movement of the Tides, by John Purser, M.R.I.A., Professor of Mathematics in the Queen's University.

Attention has of late years been directed by Mayer, Prof. James Thomson, and others, to the fact that the friction of the tidal currents on the bed of the ocean exercises an effect in retarding the earth's rotation on its axis.

The late eminent French astronomer, Delaunay, was the first, as far as I am aware, to form a numerical estimate of the possible magnitude of this effect, and to suggest that it furnishes a not improbable solution of that part of the secular inequality in the moon's mean motion which remains still unexplained.

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[*] "An attempt to establish a Relation between the Velocity of the Wind and its Force (Beaufort Scale), with some remarks on Anemometrical observations in General," by Robert Scott, F.R.S. Quart. Journ. of Met. Soc. vol. ii. p. 109.

He pointed out that inasmuch as the axis of the tidal spheroid is always behind the moon's place, a couple is exerted by the forces of the moon's attraction, which on the one hand retards the rotation of the earth, and on the other increases the dimensions of the lunar orbit.

This alteration of the lunar orbit prevents us from concluding, as we should otherwise do, that the kinetic energy which passes into heat in the movement of the tides has for its exact equivalent a corresponding quantity drawn from the store laid up in the earth's rotation on its axis.

The object of the present communication is to examine whether we can assert such an equivalence to hold approximately, and if so, to what degree of approximation. The question was started some years ago by the Astronomer Royal in the Astronomical Notices for the year 1866.

It occurred to the author that we might arrive at a solution of the problem from the information given us by the equation of energy combined with that of the conservation of angular momentum.

Let us in the first place take the case of a binary system consisting of the earth and moon, but suppose the plane of the earth's equator to coincide with that of the lunar orbit. If Q denote the energy which, during a given interval, passes into heat through tidal action, then, assuming the moon spherical and her rotation consequently unaltered, $Q = -\delta$ (energy of earth's rotation) $-\ \delta$ (energy of lunar orbit). By the energy of the lunar orbit is denoted the kinetic energy of the revolution of the earth and moon round their common centre of gravity, together with the potential energy of their separation.

Now the energy of orbit = constant $- \frac{1}{2}\, m\, m^1 \mu \frac{1}{a}$, where $m\, m^1$ represent the masses of the two bodies, μ the unit of attractive force, and a the mean distance.

Hence $Q = -\delta$ (energy of earth's rotation) $- \frac{1}{2}\, m\, m^1 \mu \frac{\delta a}{a^2}$.

Let h denote the angular momentum of the revolution of the two bodies round their common centre of gravity, H the angular momentum of the earth's rotation, then

$$\delta H = -\delta h$$

but

$$h = \frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \sqrt{a} \sqrt{1 - e^2}$$

$$\therefore \delta h = \frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \left\{ \sqrt{1 - e^2}\, \frac{\delta a}{2\sqrt{a}} - \frac{\sqrt{a} \,.\, e\, \delta e}{\sqrt{1 - e^2}} \right\}$$

When the excentricity is small the second term in this expression may be shown to be negligible when compared with the first, and we may write

$$\delta H = -\delta h = -\frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \frac{\delta a}{2\sqrt{a}}$$

$$\therefore Q = -\delta \text{ (energy of earth's rotation) } + \frac{\sqrt{m + m^1} \,.\, \sqrt{\mu}}{a^{\frac{3}{2}}}\, \delta H$$

Or if I denote the moment of inertia of the earth round her axis,
ω her angular velocity of rotation,
Ω the mean angular velocity of the moon in her orbit,

$$Q = -I\omega\,\delta\omega + I\,\Omega\,\delta\omega$$

$$\therefore -I\omega\,\delta\omega = \frac{Q}{1 - \frac{\Omega}{\omega}}$$

The left-hand member represents the loss of energy due to the slackening of the earth's rotation, and as Ω has the same sign as ω, we learn that not only is all the energy Q which is turned into heat in the motion of the tides drawn from the earth's rotation, but that, as a necessary concomitant, additional energy is transferred from the earth's rotation to the store at potential and actual energy, corresponding to the orbital motion of the system.

It also follows that when Ω is small compared to ω [in the actual case $\frac{\Omega}{\omega} = \frac{1}{27}$ nearly], the energy so transferred bears a very small ratio to Q, and that the energy lost in the earth's rotation is almost the exact equivalent of that consumed in tidal friction.

Let us now consider the case which we actually have to deal with, where the plane of the earth's equator does not coincide with the plane of the orbit.

Let G represent the resultant angular momentum of the system which will be fixed in magnitude and in direction.

θ, Θ the angles which the planes of h and H make with the plane of G.

Then, since $H^2 = G^2 + h^2 - 2\,G\,h\cos\theta$

$$H\,\delta H = (h - G\cos\theta)\,\delta h + G\,h\sin\theta\,\delta\theta$$

$$\therefore H\,\delta H = \frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \left\{ (h - G\cos\theta) \frac{\delta a}{2\sqrt{a}} + G\sqrt{a}\sin\theta\,\delta\theta \right\}$$

$$\text{Or, } \delta H = \frac{m\, m^1 \sqrt{\mu}\sqrt{a}}{\sqrt{m + m^1}} \left\{ -\cos(\Theta + \theta) \frac{\delta a}{2a} + \sin(\Theta + \theta)\,\delta\theta \right\}$$

The author proves from a calculation of the disturbing reactionary forces exercised by the tidal protuberances that the variations $\delta\theta$ and $\frac{\delta a}{2a}$ are of the same order of magnitude, although their exact ratio cannot be determined without far more complete data respecting the tides than we at present possess.

Let the ratio of the first of these variations to the second be denoted by λ, then

$$\delta H = -\frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \left\{ 1 - \lambda\tan(\Theta + \theta) \right\} \frac{\delta a}{2\sqrt{a}}.$$

$$\therefore -I\omega\,\delta\omega = I\left\{ 1 - \frac{\Omega}{\omega}\, \frac{\sec(\Theta + \theta)}{1 - \lambda(\tan\Theta + \theta)} \right\}^{-1}$$

We may therefore still infer that since Ω is small compared to ω, the energy lost in the earth's rotation is almost the exact equivalent of that consumed in tidal friction.

The same conclusion manifestly applies to the work done by a tide-mill or any other mechanism in which the tides furnish the motive power.

It would further appear that as the mean value of $\tan(\Theta + \theta)$ is less than $\frac{1}{2}$, and that of λ cannot, on any probable hypothesis of the position of the tides, be supposed to exceed unity, the coefficient of $\frac{\Omega}{\omega}$ in the above expression is positive. Hence we may conclude that, as in the simpler case previously discussed, the small transfer of energy which accompanies the principal action takes place from the earth's rotation to the moon's orbit.

All these conclusions apply *mutatis mutandis* if we regard as our binary system the earth and sun.

In the case of nature, where we have to consider the three bodies acting together, the main conclusion that all the energy lost in tidal friction is drawn from the earth's rotation will not be invalidated.

Moreover, if we assume, as is generally done, that the friction varies as the velocity, the lesser effect, *i.e.* the concomitant, transfers its energy from the earth's rotation to the energy of the orbit of the moon about the earth, and that of the earth about the sun will correspond to the values separately calculated for the binary systems.

On the construction of large Nicol's Prisms, by W. Ladd.—In January 1869 I constructed two Nicol's prisms of about $2\frac{1}{4}$ in. aperture, which in the able hands of Mr. W. Spottiswoode and Dr. Tyndall have done much valuable work, and given rise to a great demand for such prisms, both in England and America; but as the length of a good Nicol should be about three times its diameter, very great difficulty is experienced in procuring pieces of spar of sufficient purity to give such a field.

This has given rise to various methods of utilising the spar by building up prisms of shorter pieces and combining them in such a way as to unite their field of view, such as utilising four prisms of 1 in. aperture, thus giving an aperture of 2 in. Another plan I adopted was to unite two whose diameter in one direction was double that of the other; these, being balsamed together, made a very good prism; but lately I had a very good piece of spar that, but for one corner of the rhombus, which was bad, would have made a prism $3\frac{1}{4}$ in. aperture. This was, therefore, too valuable a piece to be put aside.

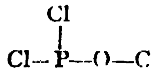
I therefore cut it at the proper angle, which took away all the bad portion; I then took another piece half the length of the first, but of the same diameter, and cut this also at the proper angle, and the bringing the two ends together gave me another complete half; these, having been balsamed together and united with the first half, produced a perfectly good prism. I may add that it is essential that the two or more pieces constituting the half prism should have their cleavage planes exactly parallel, or the image would be bent at their junction.

SECTION B—CHEMICAL SCIENCE

On the Specific Volumes of certain Liquids, by Prof. Thorpe.—Kopp found that the specific volumes of certain elements varied. Thus, the specific volume of oxygen "within the radicle" = 13·2, "without the radicle" = 7·8; of sulphur, "within the radicle" = 28·6, "without the radicle" = 22·6. "Within the radicle" was defined as meaning an instance where the oxygen or sulphur atom is united by *two* bonds to the binding element, while upon "without the radicle" it is united by only *one* bond. Kopp announced that members of the same chemical family have identical specific volumes. The author determined the specific volumes of vanadyl trichloride, $VOCl_3$, and phosphoryl trichloride, $POCl_3$, and found in the former case that the specific volume = 106·5, while in the latter it = 101·5. Kopp's law does not therefore hold in this instance. The following examples also show that as the atomic weight increases the specific volume also increases:—

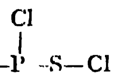
$SiCl_4$ . . . . . specific volume = 121 1
$TiCl_4$ . . . . . ,, ,, = 125·1
$SnCl_4$ . . . . . ,, ,, = 132·4

Another of Kopp's deductions is that isomers have the same specific volume; but the author found a difference between the specific volumes of ethyl-amyl and heptane, both of which are expressed by the formula C_7H_{16}; in the former case the number was 162·25, while in the latter it was 157·34. The author also determined the specific volume of the compounds PCl_3 = 93·7, $POCl_3$ = 101·5, and $PSCl_3$ = 116·3. Now, 101·5 − 93·7 = 7·8; that is to say, the specific volume of oxygen in $POCl_3$, is 22·6, hence it is without the radicle in this compound. So also 116·3 − 93·7 = 22·6; that is, the specific volume for sulphur "without the radicle." Hence the structural formula of these two substances $POCl_3$ and $PSCl_3$ will be



$\text{Cl}-\overset{\overset{\text{Cl}}{|}}{\text{P}}-\text{O}-\text{C}$

land



$\text{Cl}-\overset{\overset{\text{Cl}}{|}}{\text{P}}-\text{S}-\text{Cl}$

respectively; that is, in each case phosphorus is most probably a triad, not a pentad element.

On the Dissociation of Nitric Acid, by Messrs. Braham and Gatehouse.—Nitric acid when passed through an ordinary clay pipe at varying temperatures is split up: at the temperature of molten tin 2·10 per cent. is decomposed; at the temperature of molten lead 22 to 23 per cent. is decomposed; when the clay pipe is heated with gas 71·72 per cent. is decomposed, while when heated with charcoal 83·4 per cent. is decomposed. The gases evolved consist of oxygen, nitrogen, and nitrous oxide; the proportion of these gases it has been found very difficult to determine accurately. The following probably represents the reaction which takes place at minimum temperatures:—

$$8HNO_3 = 4NO_2 + 4H_2O + N_2O + N_2 + O_{11}.$$

When glass bulbs are partially filled with nitric acid and exposed to direct sunlight, the acid is decomposed, the amount varying with the time and intensity of the light; the decomposition is brought about by the violet end of the spectrum. If the bulbs are entirely filled with nitric acid, no decomposition ensues. After some time the decomposition ceases; this is due to the formation of nitrous acid, and if this is expelled by boiling, the decomposition again proceeds. If pure nitric acid be boiled, even to dryness, no decomposition takes place, but if the acid contains nitrous acid, then this latter is dissociated.

On the Replacement of Organic Matter by Siliceous Deposits in the process of Fossilisation, by Dr. Carpenter, F.R.S.—The author described several cases in which the internal casts of *Foraminifera* were found, consisting of silica, generally as silicate of iron. This process is now going on at the ordinary sea-bottom. Fragments of the spines of *Echinæ*, which originally contained protoplasm, have been found, in which the organic matter has been entirely replaced by silica, thus forming exact siliceous models of the animal matter. In some cases the siliceous deposit has preserved the exact form of thin tubes less than 1-10000th of an inch in diameter. The author supposed that during the gradual decay of the animal matter there had occurred a simultaneous deposition or substitution of siliceous matter in its stead.

On the Silicified Rock of Lough Neagh, by Prof. Hodges.—The water of Lough Neagh was found to contain only 12·95 grains of solid water per gallon; of this, 10·6 grains consisted of mineral matter, while 2·35 grains of organic matter were present. Of the total mineral salts a very small quantity only—less than 1 grain per gallon—consisted of ferric oxide. Samples of petrified wood were also examined: these contained on an average about 87 per cent. of silica, and a very small percentage of iron.

On a Self-registering Apparatus for measuring the Chemical Intensity of Light, by Prof. Roscoe, F.R.S.—In this communication the author described his already well-known self-registering photo-chemical apparatus.

On certain Abnormal Chlorides, by Prof. Roscoe, F.R.S.—The author drew attention to some of the chlorides of vanadium, tungsten, uranium, and sulphur. The highest chlorides which we have been able to obtain of these elements generally do not correspond with the highest oxides; thus, although we know of the oxides V_2O_5, we know of no higher chloride than VCl_4, and even this chloride is easily decomposed into VCl_3 and free chlorine. Although the oxide of tungsten, WO_3 is stable, yet the corresponding chlorine WCl_6 is very ready to split up into WCl_5 and free chlorine. So also UO_3 is a well-known oxide of uranium, yet until lately UCl_4 was the highest known chloride. The author has recently succeeded in preparing the penta-chloride UCl_5, which occurs as a light brown powder, and also as darker acicular crystals. Again, we have SO_2 and SO_3, but it is only very lately that SCl_4 has been obtained, and the compound is so unstable as to undergo dissociation at very low temperatures.—Dr. Debus suggested that the equivalency of many of the elements depends upon the element or elements with which they are united, and that hence these and other anomalous results.—The President remarked that he did not see why we should not expect to meet with examples of change of atomicity; that if we always found elements exhibiting an even, or always an odd number of atomicities, this was very remarkable, and called for explanation, but that we should not be surprised to meet with exceptions to the rule; indeed, that we could form no distinct physical idea of what we mean by "bonds of atomicity." He remarked that we cannot well use oxygen as a measure of atomicity, from the tendency which it so often exhibits of running into chains.

SECTION D—BIOLOGY

DEPARTMENT OF ZOOLOGY AND BOTANY

Dr. Moore called attention to a monstrous state of *Megacarpæa*, and also to a monstrous state of *Sarracenia*; after which he exhibited specimens of grafted roots of mangold wurzel, illustrating the transmission of special characters from the graft to the stock.

Mr. E. R. Lankester read a paper *On the genealogical import of the external shell of Mollusca*, in the course of which he referred to what has been called the recapitulation hypothesis, according to which all living things in their development present a rapid series of pictures or dissolving views of their ancestors, arranged in historical order. Applying this to the human race, he said that the earliest commencement of a human being was a small speck of protoplasm of mucus-like consistency, such as existed in ponds. A later stage exhibited him as a small sac, composed of two layers of living corpuscles, which he inherited from polyp-like ancestors, and was to-day seen in polyps. Still later he was an elongated creature, with slits in the side of the neck, which, like the gill-slits of a shark, he inherited from a shark-like ancestor. Six months after birth the child continued to inherit qualities from its ancestors, viz., from those which crawled on four legs; and at a later period certain irrepressible tendencies made it clear that qualities were inherited from climbing and shrieking animals. Mr. Lankester then went into an elaborate description of certain molluscs with a view of showing that the pen of the cephalopod is homologous with the shell of the lower Mollusca.

Prof. Huxley thought that the position had been well established. Mr. Lankester's attempt to reduce to one form the immense variety of shells in molluscous animals was exceedingly important.

Dr. Carpenter also said that he was almost prepared to receive the conclusion at which Mr. Lankester had arrived.

Dr. M. Foster added his testimony to the value of Mr. Lankester's observations, and said that part of the work accomplished was due to the establishment of the zoological station at Naples.

Mr. W. Archer read a paper *On a new form of Protozoa*, Prof. Cunningham contributed a short paper *On two Species of Crustacea*, one belonging to the remarkable fresh-water genus, the *Atya spinipes*, and the other belonging to an apparently undescribed species of the genus *Pontonia*, which are remarkable for being found as tenants of the shells of living bivalve molluscs. The two specimens were found in the Singula Archipelago.

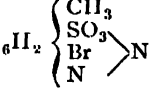
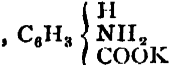
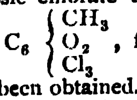
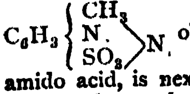
A paper, contributed by Mr. T. Lister, *On the Spring Migrating Birds of North England*, was read by Prof. Cunningham.

Mr. E. R. Lankester brought the subject of *English Nomenclature in Systematic Biology* before the department, and said it would be a considerable gain to science if there could be introduced a series of terms distinctly English in their etymology, which would be accepted as authoritative and used throughout the country. The only question was whether it was possible, by any action on the part of scientific men, to introduce such a series of terms. He suggested the appointment of a committee of men whose names would be received as authoritative throughout the country, to draw up a list of terms which should be used for the groups of the animal and vegetable kingdom.

A discussion followed, in which Prof. Thiselton Dyer, Mr. Bentham, Mr. A. W. Bennett, Prof. Cunningham, Miss Becker, Prof. Dickson, and Dr. Sclater took part, the generally expressed opinion being unfavourable to the change proposed.

A paper was read by Mr. H. Airy *On a peculiar form of Leaf-arrangement.*

SCIENTIFIC SERIALS

Justus Liebig's Annalen der Chemie, Band 172, Heft 3.—This part contains the following papers:—Communications from the chemical laboratory of Greifswald.—86. On metatoluidine, by F. Lorenz. The author describes the preparation of this substance. Paratoluidine is first treated with acetic anhydride, and para-acettoluide thus obtained, which, by treatment with nitric acid, yields metanitropara-acettoluide. By heating with alcoholic potash this latter substance is converted into metanitroparatoluidine; this last body is acted on by nitrous acid, and the diazo-compound treated with alcohol leaves metanitrotoluol, which, by reduction with tin and hydrochloric acid, gives metatoluidine. Several of the salts of this base are described, likewise the conjugate sulpho-acids, dibrominated substitution derivatives, &c.—87. Note on the quantitative determination of paratoluidine in presence of orthotoluidine, by the same author.—88. On metabromorthosulphotoluic acid, by Dr. E. Weckwarth. The preparation of this acid, which possesses the formula  $C_6H_2\left\{\begin{array}{l}CH_3\\SO_3\\Br\\N\end{array}\right\rangle N$ is described. The potassium, sodium, barium, strontium, copper, and lead salts have been analysed, and the chlorine, amido, and nitro substitution derivatives examined.—89. On orthoamidoparasulphotoluic acid, by Dr. M. Hayduck. The barium and lead salts are first described; the brominated acid and its potassium, barium, and lead salts are next treated of. The amido acid distilled with potassic hydrate gives off ammonia, and aniline and a potassium salt of anthranilic acid,  $C_6H_3\left\{\begin{array}{l}H\\NH_2\\COOK\end{array}\right.$ is obtained. With hydrochloric acid and potassic chlorate the amido acid yields trichlororthotoluquinone,  $C_6\left\{\begin{array}{l}CH_3\\O_2\\Cl_3\end{array}\right.$, from which the corresponding hydroquinone has been obtained. By the action of bromine on the amido acid a dibrominated acid is obtained, of which the barium salt has been analysed. Diazo-orthoamidoparasulphotoluic acid,  $C_6H_3\left\{\begin{array}{l}CH_3\\N\\SO_3\end{array}\right\rangle N$, obtained by the action of nitrous acid on the amido acid, is next treated of. This body acted on by water gives orthocresolparasulphonic acid. The nitro-diazo acid is finally described.—90. On a new nitro-toluidine, by Dr. O. Cunerth.—On paramido-orthosulphotoluic acid, by Dr. F. Jenssen. The nitro-acid, $C_7H_6(NO_2)SO_3H \cdot 2\frac{1}{2}H_2O$, and several of its salts are described, also the chloride and amide. The amido acid is then treated of, likewise its salts and substitution derivatives.—On some decompositions of pyroracemic acid, by Dr. C. Böttinger. This lengthy memoir is divided into three sections: the first treats of the decomposition of the acid in acid solutions, the second of its decomposition in alkaline solutions, and the third of its decomposition *per se*. Among other things the author describes in great detail the preparation and properties of uvic acid and its salts.—On acenapthene and naphthalic acid, by Arno Behr and W. A. Van Dorp. The authors have examined several of the salts of the acid, its methylic ether and anhydride. The constitution of the two bodies is also discussed.—Researches on the volume constitution of solid bodies, by Dr. H. Schröder.—K. Helbing contributes a paper on an examination of some benzene liquors, and one entitled "Research on a new earth resin." This resin is found in large masses in a stone quarry at Enzenau, between Tölz and Heilbrunn. Nineteen per cent. of the resin is soluble in ether, and nine per cent. in ether and hot alcohol. The insoluble portion contains iron pyrites and a hydrocarbon of the formula $C_{40}H_{62}$. The ethereal extract contains a substance of the formula $C_{40}H_{62}O_2$, melting at 192°. The hot alcoholic extract gave a substance of the composition $C_{40}H_{60}O_8$.—On cymene, by F. Fittica. The author establishes the identity of the cymenes from camphor, ptycholisol, and thymol, and furnishes evidence that the propyl contained in the cymenes is normal propyl. The isomeric oxy- and thio-cymenes are also treated of.—The constitution of benzene, by A. Ladenburg.—On derivatives of phloretin, by Hugo Schiff. The author treats of the preparation of phloretin, of phloretic acid, and phloroglucin, likewise of phloroglucide and of triphloretide. The present part contains the index for vols. 169, 170, and 171.

Zeitschrift der Œsterreichischen Gesellschaft für Meteorologie, Aug. 15.—Dr. H. Wild contributes to this number some suggestions for the consideration of the Permanent Committee of the International Congress on the question of the establishment of an International Meteorological Institution. Before the Congress at Vienna he was altogether in favour of the scheme, but now feels persuaded that one institution could hardly exercise the large functions proposed with advantage. The difficulty of directing from one spot a number of stations scattered over the globe would be great, the conditions of these stations would not be familiar, the construction of isobaric charts, &c., could only be undertaken with exact data and co-operation of the central national offices, and the modification of instruments, &c., would not be a proper task to be attempted at any one place, with its narrow range of climatic conditions. The failure of one of the central offices would cripple the results produced by the Institution, and, besides, the energetic working of these offices would be endangered if they were to delegate some of their present problems to the Institution. The national offices which now occupy themselves with general meteorology might bestow too much attention to local matters. These objections would be avoided if each central office were to attend specially to some branch of the meteorology of the globe mutually agreed upon; for instance, one to the preparation of synoptic charts, another to rainfall, and so forth. The results of the various lines of research could then be interchanged, and the failure of one office would not damage the work of the others. The establishment and maintenance at common expense of international stations proper in uncultivated countries, and the publication of their observations, Dr. Wild holds would be best undertaken by the countries to which these stand in the nearest relation. There would remain, then, for the Institution the work of interchanging the results and keeping up the relations of central offices, the arrangement of occasional Congresses, questions concerning instruments, and the like.—Among the *Kleinere Mittheilungen* we observe an abstract of the important report of Mr. Blanford to the Government of Bengal for the year 1873.

Poggendorff's Annalen der Physik und Chemie, No. 5, 1874.—In 1868 Prof. von Rath published some observations on a form of silica to which he gave the name Tridymite. It always crystallises in twin hexagonal prisms, and has a low specific gravity. His further observations show lines of division between the elements forming the twins, and in these lines the third crystal in tridymite is developed. There is a similar persistence of the division plane between crystals of humite, and analogous triple crystals in anorthite, and an interlacing of crystals in leucite; and he concludes that while two crystals cannot be united to each other in many crystal groups, yet they can be united to a third crystal. Fine specimens, three millimetres long, reaching him from the trachytes of Pachuca in Mexico, he has made full measurements. The crystals, however, are generally of small size relatively to the accompanying minerals. They commonly occur in drusy cavities of the trachytes associated with specular iron, hornblende, and augite. Details are given of the mode of growth of the twins, their various forms and intimate combinations.—Another paper by the same author describes a remarkable crystal of calc-spar from Lake Superior. It is shown by the formulæ of the faces to be a form which is distinct from any hitherto observed. It is transparent, and occurs with native copper in amygdaloid melaphyre.—Another paper by Von Rath is on a singular combination of rutile and specular iron. The fine spiculæ of rutile are developed from between the plates of a red kind of specular iron, and may be a subsequent formation. It occurs in association with crystals of quartz and adularia in clefts or druses in a fine grained talcose gneiss.—Von Rath's next paper is On remarkable artificial crystals of pure copper. At the meeting last year of the German Geological Society at Weisbaden, Prof. v. Seebach exhibited crystalline copper which Prof. Senft of Eisenach had obtained by galvanic electricity between small rings of zinc and copper. From an aggregation of very small crystals a large mass was formed of the size of four millimetres. The crystals are always twins, with the free end most produced, and have a form which has not heretofore occurred in native copper, though it has been found in galena and binnite. The octahedral faces of the crystals are flat and shining, while those of the icositetrahedron are curved and less perfect.—Another paper discusses the hypersthene of Mont Dore, described by Des Cloizeaux, a mineral which there occurs in druses in trachyte in crystals three millimetres long, associated with crystals of sanidine and tridymite.—Von Rath's last memoir describes a new zeolite, named foresite, from the tourmaline granite of Elba.—Prof. Th. Petruschevsky, of St. Petersburg, who has devoted himself since 1862 to the phenomena of magnetism, now publishes the results of his investigation on the direct and indirect determination of the pole in magnets. Starting with the basis of Biot's curve of magnetic intensity, he points out that it is as easy to determine the pole theoretically as empirically, details his two methods, and the apparatus wherewith they are tested. He then considers the determination of the pole in electro-magnets, and finally enumerates results.—Dr. Gustav Junghann explains a simple law for the development and grouping of crystal zones. He introduces some maps of anorthite into the memoir, in which the formulæ of the faces are all set down in tabular form in square spaces.—Herr G. Hagen contributes a memoir On the resistance offered by the air to plane discs moved through it.—Herr J. J. Müller examines one of the Hamiltonian theories of movement which underlies the principles of mechanics.—Herr von Laspeyres has an interesting experimental paper On the existing and a new thermostat, and Herr Rammelsberg describes the crystalline form and modifications of selenium.—The most interesting reprinted paper is Terquem's account of the vibroscope for accurately determining number of vibrations.

SOCIETIES AND ACADEMIES

LEEDS

Naturalists' Field Club and Scientific Association, Sept. 15.—Mr. Edward Thompson, vice-president, in the chair. —Mr. James Abbott mentioned that he had gathered *Butomus umbellatus* in flower at Kirkstall, on Sept. 12. The plant had not been noted in the Leeds district for upwards of twenty years past, when it grew in the stream at the foot of Woodhouse Ridge. —Mr. Henry Pocklington, in conjunction with Mr. James Abbott, demonstrated the action of the induced current upon the protoplasmic gyrations in the cells of *Vallisneria spiralis*, by means of a simple electric slide and a small inductorium. The effect produced was very marked. The circulation of the protoplasm stopped almost instantly. It was, in fact, as was described by one of the members, as though a strong "break" were put on. The protoplasm was corrugated by the rapid contractions induced, and the results taken altogether were of the most interesting character. Mr. Pocklington will probably communicate a more complete description of his apparatus and its results at an early date.

PARIS

Academy of Sciences, Sept. 21.—M. Bertrand in the chair.—The following papers were read:—Note on barium sulphocarbonate, by M. P. Thenard. Since M. Dumas' proposal to use sulphocarbonates for the destruction of *Phylloxera* these salts have acquired a new interest. The barium salt i easily prepared by agitating a strong solution of barium sulphide with carbon disulphide. The author describes a process for manufacturing this salt on a large scale, and proposes to turn his attention to the manufacture of the potassium salt.—On a new mercury pump, by M. de Las Marismas. This apparatus is stated to cost 35 francs, and to exhaust a receiver of six litres' capacity to one millimetre pressure in four minutes; all pressures from that of the atmosphere up to an absolute vacuum can be obtained, the gas contained in the receiver can be collected if necessary, and a vacuum can be preserved indefinitely.—On the action of alimentary or medicamental liquids on tin vessels containing lead, by M. Fordos. The author has tried the action of wine, vinegar, lemonade, &c., upon hospital vessels containing 10 per cent. of lead; this latter metal was invariably found in the fluids used, and the author concludes that the use of this alloy may be attended with great danger.—Researches on the colouring matters of garancine, by M. A. Rosenstiehl. The colouring materials of garancine—alizarine, pseudopurpurine, purpurine, and its hydrate—have all been investigated in great detail by the author. Purpurine and its hydrate are formed at the expense of pseudopurpurine; the products of the reduction of purpurine have been studied, and two isomers of this body obtained, one of which has been prepared by synthesis starting from benzoic acid. Pure alizarine is prepared by heating the commercial substance with water to 200° C. for some hours, a small quantity of caustic alkali being added. Impurities are totally destroyed by this treatment, and the product of the operation is further purified by frequent crystallisations. Pseudopurpurine is a very unstable body; heating with water or alcohol transforms it into a mixture of purpurine and its hydrate. From the present researches it seems that garancine red and the rose colouring matter yielded by garancine flowers cannot be obtained from alizarine alone; the presence of purpurine or its hydrate is indispensable. The product of the action of reducing agents on purpurine and its hydrate is purpuroxanthine, an isomeride of alizarine.—New experiments on the nature of the sulphuretted principle of the waters of Luchon, by M. F. Garrigou. This is a reply to a paper by M. Filhol in the *Compt. Rend.* for Sept. 7.—Observations relating to a recent communication by M. Lichtenstein on some points in the natural history of *Phylloxera vastatrix*, a letter from M. Balbiani. The author again enforces his views as to the non-identity of the *Phylloxera* of the vine and of *Quercus coccifera*.—M. P. Thenard made known to the Academy the measures adopted by M. le Prefét de Saône-et-Loire on the approach of *Phylloxera*.—M. le Ministre de l'Agriculture et du Commerce and M. le Ministre des Finances consulted the Academy on the employment of tobacco juice for the destruction of *Phylloxera*.—Communications relating to *Phylloxera* were also received from MM. J. Bond, H. de Martiny, R. Delpit, &c.—Properties of the "implexes" of surfaces defined by two characteristics, a geometrical note by M. Fouret.—On luminous diffusion, by M. A. Lallemand.—On Warwickite, by M. J. Lawrence Smith. The author assigns to this mineral the formula $\dot{Mg}_5\ddot{B}_3 + (\dot{Mg}\dot{Fe})\ddot{Ti}_2$.—On the *rôle* played by gases in the coagulation of blood, by MM. E. Mathieu and V. Urbain.—On the movement in the bilabiate stigmata of the Scrophulariaceæ, Bignoniaceæ, and Sesameæ, by M. E. Heckel.—Observation of a bolide at Versailles on the evening of the 14th of September, by M. Martin de Brettes.

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ERRATUM.—Vol. x. p. 416, col. 1, line 22 from bottom, for "Norway" read "Moray."

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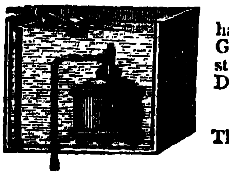

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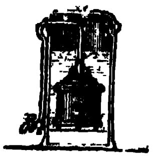

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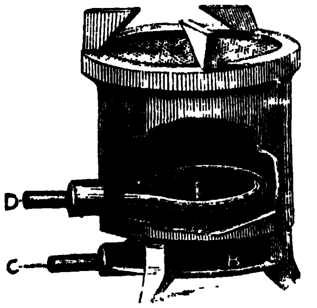

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THURSDAY, DECEMBER 24, 1874

PROTECTION FOR INVENTIONS

THAT most active and practical body, the Society of Arts, persevering in its endeavours to place our Patent system on an efficient footing, has devoted four evenings to the discussion of the question, the debate being led off by Mr. F. J. Bramwell, C.E., F.R.S., in a paper the ability of which has been warmly and justly extolled on all sides, alike by opponents and supporters, without a dissentient voice.

Mr. Bramwell, being circumscribed by the narrow limits of a short address, confined his attention principally to the question whether or not patents should be abolished. He probably foresaw that the discussion thus provoked would cover wider ground and examine the further question whether the system of patents, if preserved, does not admit of improvement. And it accordingly turned out so, for the latter question was much more fully discussed than the former.

The unanimity of opinion, indeed, as to the expediency of continuing to grant patents for inventions was most remarkable, the principal, if not the only dissentient, being Mr. John Horatio Lloyd, Q.C. This eminent legal authority, who in his evidence before the Parliamentary Committee urged the abolition of patents, now came forward, it is true, to declare that his opinions had undergone a change, and "expressed a reluctant acquiescence, though not a settled conviction, as to the expediency of protection for patents;" and he may therefore object to be ranked amongst the dissentients. We must refer to his speech as our justification for so placing him. This speech may be commended to metaphysicians, as throwing great light on the question whether the soul and the mind of man are distinct and separate. Mr. Lloyd's soul evidently hateth patents, but his mind perceives their necessity. His mind is only permitted to admit this necessity in the brief sentence we have quoted, and his soul then for the space of an hour employs every artifice of rhetoric to prove that the mind's admission is unwarrantable and unsound. In no other way can the discrepancy between the arguments and the conclusions be explained. It is impossible that they can both emanate from one and the same mind, and that an unusually acute mind. They issue, obviously, from two distinct and indeed antagonistic sources. It is not often that the spectacle is afforded us of a good and able man the helpless sport of a psychological contest. Mr. Lloyd's speech settled the main question. Skilful though it was, and delivered with the gentlemanly grace natural to him, the meeting was against him to a man, and listened to him, latterly, even with impatience. After he sat down, no one attempted the task, in which he had so signally failed, of proving that patents are injurious to the community, and, assuming them to be abolished, of providing an effective substitute.

The discussion then turned chiefly on the defects of the present English system and on the peculiar features of some foreign ones, particularly that of the United States, which was alternately approved and condemned. And here, as in mixed assemblages of Englishmen generally, there was much running after details, much reliance on illustrations, and but a small modicum of broad and systematic treatment. The point principally dwelt on was the necessity for a preliminary examination of patents. This, two members of Parliament—Mr. Hinde Palmer, Q.C., and Mr. Samuelson—informed the meeting, had been recommended by a Committee of the House of Commons on which both speakers had sat; but though some years had elapsed, no steps had been taken in the matter. Col. Strange caused a sensation by stating that the Patent Commissioners had applied to the Council of the Royal Society to nominate one of three eminent men of science who should perform this herculean task without salary, and that that learned body had, much to its credit, scouted the idea. This elicited strong expressions of opinion on the absurdity, injustice, and inexpediency of grudging to scientific men alone, of all those whose labours directly benefit the community, the liberal remuneration to which they are entitled. We have more than once brought this question before our readers, as one of those on which views are held in some quarters having a most prejudicial effect on those scientific reforms which are so urgently needed in England. We have never urged the proper remuneration of scientific labour on the grounds of mere philanthropic liberality to the labourer, but on the much higher ground that it is for the benefit of the nation materially, not less than for that of knowledge, that prospects should be held out of a career to those possessing talents and tastes for scientific pursuits. At present no profession, scarcely any occupation, holds out such small inducements to the rising generation of educated Englishmen as science. It needs no argument to prove that this passive discouragement of one of the spheres of intellectual activity most fruitful of advantages to mankind must have very injurious results, as we know from every-day experience that it has. We are glad to find that Mr. Bramwell, in his masterly summing up of the debate, ranged himself vigorously on our side of this important question; and it was with pain that we noticed expressions in the contrary sense, dropped, we trust inadvertently, by Mr. Samuelson, who, as a member of the Duke of Devonshire's Science Commission, must be well aware how much science suffers by the narrow neglect with which, as a nation, we treat the investigators of nature.

But to return to the question of a preliminary examination of patents.

There was some difference of opinion, though not of an irreconcilable nature, as to the expediency of this measure. It was too much assumed, even by Mr. Bramwell himself, that if such an examination were established here, it would necessarily be conducted in the same manner and with the same objects as in America—a perfectly gratuitous assumption. In America patents are examined mainly for novelty and utility, and are often rejected for failure in either respect. It is apprehended that, since inventors are often in advance of their age, an indiscriminate exercise of the power of rejection may retard the introduction of useful improvements—and several alleged instances of this were adduced. It is not always safe, however, to argue by illustration alone. The illustration may be inaccurately stated or wrongly applied, as in the case of one of those cited by Mr. Cole, who said that the power of rejection "would have prevented the building of the Crystal Palace, which wise men said must

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inevitably be blown down." The speaker no doubt had before his mind an imperfect recollection of the discussion which followed the reading of Mr. (now Sir Digby) Wyatt's paper on the first Great Exhibition building at the Institute of Civil Engineers in January 1851, when one "wise man," the present Astronomer Royal, objected to so purely rectangular a structure of iron, and insisted on the necessity for adding diagonal braces, giving at the time a full demonstration of his views. The question was one of Elementary Mechanics, which should have been better understood than it seems to have been. The "wise man" was right, as is proved by the adoption of his suggestion in the construction of the Crystal Palace; and his dictum, so far from retarding or preventing its erection, has probably saved that and similar structures from a hideous catastrophe. This is an instance of a wrongly applied illustration telling strongly against the argument it was intended to enforce. The power of rejecting patents is one, however, which, we fully admit, if conceded at all, should have its limitations, and should be exercised exceptionally rather than generally. But the staff which, under the American system, exercises this power, as some think too freely, is still indispensable for other purposes, as pointed out by Mr. Bramwell in his concluding address. They should, as a matter of duty, be ready and able to afford to inventors the fullest information, and should render them all reasonable assistance in steering clear of those shoals which must surround any patenting system. They should do this, not merely out of kindness to ignorant though ingenious inventors, but on behalf of the community, whose interest it is that a really useful improvement should be introduced in the most perfect possible shape. They should also revise specifications, which, often in ignorance, and sometimes from motives of questionable honesty, vaguely, imperfectly, or incorrectly set forth the invention. They would also sit with the judges on the trial of patent cases, affording that technical and scientific knowledge of the matters at issue in which it is admitted that both the Bar and the Bench are deficient.

In the consideration of this most important question, one of the uses of a well-organised patent system has hitherto been too little noticed—namely, that it may be made, both directly and indirectly, a powerful instrument of public instruction. A body of highly qualified responsible men, eminent in different departments of science and technology, acting in concert, and having at their command the resources and influences of a great department founded specially for introducing material improvements, including a complete collection of all the machines and appliances of manufacturing industry, and all the instruments and apparatus used in both abstract and applied science, which they should explain in public lectures, could not fail to disseminate widely that peculiar class of knowledge which it is found so difficult to engraft on any ordinary educational system.

Nor is this the only important point that entirely escaped notice in the recent discussion. The present constitution itself of the Patent Office was not challenged. It seemed to be considered that this having been, not very long ago, settled by a Committee of the House of Commons and an Act of Parliament, must be taken for granted as inevitable and unassailable. But fifty committees and acts of the Legislature should not suffice to preserve a constitution so inherently bad. What is it? The Patent Office is governed by four commissioners, the Lord Chancellor, the Attorney-General and the Solicitor-General for the time being, and the Master of the Rolls. Of these four, not one is presumably qualified by special knowledge, and three out of the four are liable to change frequently with changes of the Ministry. Nor is it even expected that any one of the four can or will give a moment of his time to Patent Office duties. The late Lord Chancellor candidly avowed to a deputation of the Society of Arts that he had never once entered the Patent Museum. The Master of the Rolls presides over perhaps the hardest worked court in the kingdom. And the two law officers, besides their duties as advisers to the Crown, are encumbered with their still more exacting duties to themselves as barristers in large practice. Notoriously and avowedly these four high legal functionaries leave the Patent Office to the care of its clerical staff. Should so monstrous an abuse be suffered to continue? Is it possible that, whilst it continues, necessary reforms will be introduced and efficient administration maintained? Nothing is more obstructive and more demoralising than a sham—and no worse or more glaring sham than this exists at the present day in a country in which shams are not very few or very retiring. The remedy is perfectly obvious. The Patent Office should be under a Minister of the Crown, directly responsible to the nation through Parliament for its good government. The Society of Arts have been for some time most properly urging that the Patent Museum, considerably expanded, should be placed under a Minister, with other Museums. Surely they cannot contemplate such a disruption of the whole system as would be perpetrated by placing the Museum under one authority, and the office to which it is an adjunct under another. We trust therefore they will insist that the whole system should be ministerially governed. For the present we abstain from indicating the particular Minister who should have charge of this and similar institutions, not because the appropriate arrangement is at all doubtful, but because our space today does not admit of our delineating it with the necessary fulness.

In conclusion, we hope that the unanimity in the late debate and in the press, in favour of retaining Patent Laws, will silence effectually the feeble cry for their abolition which from time to time contrives to make itself heard. No one can now, at any rate, be considered qualified to raise that question who has not read this discussion, and especially Mr. Bramwell's two closely reasoned masterly addresses.

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THE opinion which we expressed of Dr. Livingstone's character and of the value of his work, when the sad tidings of his death reached this country last spring, is amply confirmed by the simple narrative before us. No one, we presume, who knows the work that Livingstone has done, and how he has done it, will hesitate to place him in the front rank of explorers, and award him a niche among the few whom men deem worthy of the highest and most enduring honour. It is, we believe, the simple truth to say that he has done more than any other man to fill up that vast blank in inner Africa which in the maps of twenty or thirty years ago was occupied only by the word "Unexplored" in large and widespread letters, delightful enough to the hearts of lazy schoolboys. Now, what with the labours of Livingstone in the south, and those of Baker, Burton, Speke, Grant, and others in the north and north-east, this blank space is reduced to a comparatively small circle around the equator on the 20th degree of east longitude. We have no doubt that within the space of the next twenty years, or less, the heart of Africa will be as fully and accurately mapped as that of South America, if indeed not more so. And when the geography of this region of the earth is complete; when science shall have been enriched with the knowledge of its multitudinous products organic and inorganic, when a legitimate commerce shall have brought its many blessings to the native population, who seem possessed of many capabilities for good; when Central Africa shall have taken its place among the civilised nations of the world—the memory of David Livingstone will be cherished by its peoples as worthy of the greatest reverence and gratitude. It will be long ere the tradition of his sojourn dies out among the native tribes, who, almost without exception, treated Livingstone as if he were a superior being; indeed, had it not been for the baneful influence of the Arab slave-traders, and the troubles which arose from the debased characters of the majority of his own retinue, Livingstone's last journey would have been one of comparative ease, would have been accomplished probably in about half the time, might possibly have been even more fruitful in results than it has been, and, above all, he himself might now have been among us, receiving the honours which he so nobly won.

As it is, we are thankful for the grand results that Livingstone has left behind him, which he achieved in the face of difficulties that would have daunted almost any other man, and which in the end brought himself to death; thankful are we also to the brave and loyal Susi and Chuma, who stuck so faithfully to their master, and preserved so religiously the invaluable record of his achievements. Their conduct has won for them the admiration of the civilised world, and their care for their master's remains has earned for them the gratitude of all Englishmen.

If this record of Livingstone's last wanderings is a sad one, it is not on account of any wailings that escape from the traveller himself. His journals were faithfully kept day after day, but the entries in them are brief, though pregnant. He wastes no useless words on his sufferings; nearly every sentence is a statement of an observed fact. Indeed, he distinctly says, when his difficulties began—and they began at the beginning—that he looked upon all his troubles as necessarily incident to the work he had set himself to do, and to be taken no more account of than the little difficulties which everyone must look for in carrying out his work in the world. Like all really great men, he did his work and made no fuss about it. Until near the end, when his sufferings must have been extreme, nothing like the cry of an afflicted man escaped him; his difficulties of all kinds were regarded merely as hindrances to the great work which he was so anxious to achieve. His journal is written in the simplest style, and never betrays any consciousness on his part that he was doing anything very extraordinary. His was no attempt to accomplish a mere traveller's feat; he had a definite task before him—the exploration of the lake region of Central Africa, a task which he never once lost sight of. True, in the end, his work concentrated itself on the discovery of the four fountains of Herodotus, which he expected to find away to the west of Lake Bangweolo, and among which he firmly believed he would find the long-sought-for source of the Nile. It was on the road to these supposed fountains that he died; had he lived to discover them or to disprove their existence, he would have considered his work as an explorer at an end, and would have returned to spend his remaining days at rest among his friends.

Livingstone's theories as to the sources of the Nile may very possibly turn out to be mistaken; but this can in no way detract from the value of his work. The "Nile mystery" cannot now long remain unravelled; but, compared with the large and substantial achievements of Livingstone, the solution of this is little more than that of an ingenious puzzle. Under all circumstances, Livingstone must ever stand forth as one of the world's greatest explorers, not only on account of his own immediate discoveries, but on account of the impetus which he has given to African discovery; for it is mainly owing to the enthusiasm generated by his noble example that so much has been done during the last thirty years to fill up the great blank on the map of Africa. His own travels, extending over a period of thirty years, embraced an area of some millions of square miles, reaching from the Cape to within a few degrees of the equator, and from the mouth of the Zambesi to Loango. And, as we have said, his aim was not to get over so much ground in the shortest possible time, and return to reap the reward of his feat. Like the native Africans, he travelled slowly and leisurely by short stages, mainly on foot, carefully and minutely observing and recording all that was worthy of note in the natural productions and phenomena of the region over which he travelled, studying the ways of the people, eating their food, living in their huts, and sympathising with their sorrows and joys. Already have various departments of science been enriched by his observations; and, what is perhaps of more importance, he has shown that in Africa a fertile field remains for the minute observations of the trained naturalist, ethnologist, geologist, and meteorologist.

It is impossible in the space at our disposal to give any adequate idea of the results of his last seven years' journeys. Indeed, as we have said, the records in his journals are so terse, there is so little of what is superfluous and so much of the highest value, that anyone wishing to have a satisfactory notion of what he accomplished must go to the work itself. Mr. Waller has wisely printed the journal as he found it, making no attempt at a systematic arrangement of the material; this will, no doubt, be done gradually, and the observations which he made day by day take their place in the various sciences to which they belong. We are glad to see from the preface that there still remains for future publication a valuable mass of scientific observations. "When one sees," to quote the preface, "that a register of the daily rainfall was kept throughout, that the temperature was continually recorded, and that barometrical and hypsometrical observations were made with unflagging thoroughness of purpose year in and year out, it is obvious that an accumulated mass of information remains for the meteorologist to deal with separately, which alone must engross many months of labour." We hope that no time will be lost in giving the world the benefit of this valuable material.

A Fish-Eagle on a Hippopotamus Trap.

We shall briefly run over the ground traversed by Livingstone. He left Zanzibar on March 19, 1866, in the *Penguin* for the mouth of the Rovuma in about 10½° S. latitude. His company consisted of thirteen sepoys, ten Johanna men, nine Nassick (Bombay) boys, two Shapanga men, and two Wayaus (South Africans), Wekatani and Chuma. He had, besides, six camels, three buffaloes and a calf, two mules, and four donkeys. This seems an imposing outfit, and so it was, but it soon melted away to four or five boys. Rovuma Bay was reached on March 22, and a start for the interior was made on April 4. His course for the first three months was mainly along the banks of the river Rovuma, turning south-west after a march of about 300 miles, towards the south end of his own Lake Nyassa. On starting he has recorded some reflections on the advantages of travelling, which, for their own value and as giving an insight into the character of the man, we wish we had space to quote. The first part of his course was through a dense jungle, and here the botanist will find some observations worthy of his attention. The gum-copal tree is here in great abundance, and some curious geological phenomena are noted. Ere he reached the Nyassa he had to send his sepoys back, as they were worse than useless; a set of lazy, degraded blackguards, whose brutal usage of the animals and that of the Johanna men, left him in the end with only his goats and a little dog. The Johanna men, ere they were well round the end of the lake, deserted,[*] and Livingstone was no doubt well rid of them, though it left him with so diminished a retinue that it made him dependent on native carriers, who were often difficult and expensive to procure. However, this was an evil that gradually lessened as he went on; for as he conscientiously paid his way wherever he went, his baggage was gradually diminished to no great bulk. In the first part of the route, also, the party frequently suffered from want of food, an evil which was of but too frequent occurrence during the long and intricate journey, not so much from unwillingness on the part of the natives to give or sell it, but simply because the brutal half-caste Arab slave-dealers, who were met with everywhere, had so desolated the country that the terrified and demoralised people were often themselves famishing. The horrors of this trade, "the open sore of the world," as Livingstone calls it, are shown on almost every page of this journal, and one of the sorest trials which the humane traveller had to endure was to be an almost daily witness of its inconceivable cruelties, and to feel himself powerless to help. Even in this matter, however, we believe his words and example will have had a good moral effect on many of the native chiefs, if not on the degraded dealers; for the people are so demoralised by the latter, that they hunt and sell each other. This Arab slave-hunting was a great hindrance to Livingstone's progress, as the dealers had so terrified the people as to make them suspicious of every stranger, and; with one or two creditable exceptions, did all in their power to poison the native mind against the white man, for they knew that he regarded their doings with unmitigated disgust. No good can come to Africa, and no exploration of her rich interior can be carried out with complete success, until this cruel traffic is abolished; and in the interests of science as well as humanity, we hope that the British Government will never cease to use its powerful influence until it is stamped out. We only wish that the Sultan of Zanzibar, whose subjects the half-caste traders nearly all are, could be induced to follow the example of the Khedive of Egypt, and depute some man of determination and vigour to sweep the interior of the entire horde of slave-hunters.

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[*] It will be remembered that these men screened their cowardice by spreading a report of Livingstone's death.

And here we cannot help saying that we almost wish that Livingstone had possessed some of Pasha Baker's wholesome sternness and disregard to the trivial scruples of his men and of petty village chiefs. It would have saved him many annoyances, and might in the end have been the means of saving his life. But he was so full of the great object of his mission that he did not care to waste the time and energy required to bring his low-minded sepoys and Johanna men under discipline; and his conscience was so tender, his humanity so strong, and his desire to live at peace with all men so much of a religion, that he would rather stay weeks at a village to suit the caprice of its childish chief than break away at the risk of giving offence or provoking hostility. His genuine tenderness of heart peeps out unconsciously every now and then, his charity was wonderfully wide, and his forbearance often almost annoying.

Lake Nyassa was reached on August 8, and passing down its east and round its south side, Livingstone struck out in a generally N.N.W. direction for the south end of Lake Tanganyika. We need scarcely say that this part of the journal, recording a journey through a country much of which had not hitherto been explored, is full of valuable notes on geology, botany, zoology, geography, topography, and the manners and customs and connections of the people. Here, as in almost every other part of his journey, the number of streams met with flowing into the great lines of drainage is astonishing; a dozen would sometimes have to be crossed in a day's march. After rounding the south end of Nyassa, however, he first met with those bogs, or earthen sponges, which abound also around Lake Bangweolo, and in the midst of which, and no doubt partly through their malarious influence, he died.

"The bogs, or earthen sponges, of the country," he says, "occupy a most important part in its physical geography, and probably explain the annual inundation of the rivers. Wherever a plain sloping towards a narrow opening in hills or higher grounds exists, there we have the conditions requisite for the formation of an African sponge. The vegetation not being of a healthy and peat-forming kind, falls down, rots, and then forms thick dark loam. In many cases a mass of this loam, two or three feet thick, rests on a bed of pure river-sand, which is revealed by crabs and other aquatic animals bringing it to the surface. At present, in the dry season, the black loam cracked in all directions, and the cracks are often as much as three inches wide, and very deep. The whole surface has now fallen down, and rests on the sand; but when the rains come, the first supply is nearly all absorbed in the sand. The black loam forms soft slush, and floats on the sand. The narrow opening prevents it from moving off in a landslip, but an oozing spring rises at that spot. All the pools in the lower portion of this spring-course are filled by the first rains, which happen south of the equator, when the sun goes vertically over any spot. The second, or greater rains, happen in his course north again, when, all the bogs and river-courses being wet, the supply runs off, and forms the inundation: this was certainly the case as observed on the Zambesi and Shiré, and, taking the different times for the sun's passage north of the equator, it explains the inundation of the Nile."

This is an important observation with regard to the Nile, though it may very well turn out that Livingstone himself was mistaken with regard to its source or sources. He found, as we have said, the same phenomenon in a much higher degree on the east and south sides of Lake Bangweolo, and believed it to be "the Nile, apparently enacting its inundations, even at its sources."

We wish we could linger with the traveller and speak in detail of some of the multitude of interesting observations he made as he sauntered along. The people themselves between Nyassa and Tanganyika are full of interest to the ethnologist, the sociologist, and the student of the ways of men. Their physique and intelligence are of a high order, and they have scarcely any of the negro characteristics. They are by no means savages, and in almost every village Livingstone was well and kindly treated by the chief and his people. There is no such thing as a national bond of union here, each village being a separate community, presided over by its chief. The region here, as everywhere else in Livingstone's journey, is thickly populated. The people are polite, industrious, and on the whole peaceful, the great disturbers of their peace being the Mazitu, a people to the north of Nyassa, who rove far and wide in search of slaves, leaving death and desolation in their track. The great industry here, and over a great part of the region visited by Livingstone, is the smelting and manufacture of iron, which is obtained in abundance from various ores. In this industry the people display considerable skill and ingenuity, and manufacture the metal into a great variety of implements, utensils, and weapons. Each tribe has its separate tattoo badge. The country itself, hilly, and well wooded, is of the most fertile kind, and abounds in buffaloes, elands, haartebeest, and other large animals, and evidently with not a few birds that are new to the zoologist.

(*To be continued.*)

INDIAN METEOROLOGY

Report of the Meteorological Reporter to the Government of Bengal for 1873. By Henry F. Blanford, Meteorological Reporter.

MR. HENRY F. BLANFORD'S annual Meteorological Reports for Bengal, of which this is the seventh, have come to be looked forward to with much interest by meteorologists, as not only model monograms of the subject discussed by them, but as further developing and occasionally opening up certain lines of inquiry which lead to practical applications of the science. In these respects the Report for 1873 is the best, as well as the most suggestive. Its outstanding feature is the discussion of the deficient rainfall of the Presidency during 1873, so disastrous by the famine which followed it; and the developing in the course of the discussion of a principle which, if confirmed by future observations, "will enable us to some extent to forecast our [Indian] seasons, or at least to speak with some confidence to their probable character for some months in advance."

From the increased number of stations now in connection with the department, and from the additional data obtained from the meteorological superintendents of the Governments of Ceylon, the Upper Provinces, Central India, and Berar, it is possible to form a conception of the geographical distribution of pressure, temperature, rain, &c., over one-half of India and its seas. The summaries of all the observations made over the region during the past seven years form an admirable feature of the Report. We very cordially join in the hope expressed that the observations which have been made in the Presidencies of Bombay and Madras will in future be accessible, and that those made in the Punjâb will be put on such a footing as to be trustworthy and comparable. As regards the last-named region, in all the annual reports we have seen (down to 1870) the barometric observations are given uncorrected for temperature and unaccompanied with the readings of the attached thermometer! When, on making the annual survey of the meteorology of India, the north-west, west, and south of the country can be included, it will be possible to write the history of the two monsoons of the year, and probably to point out the determining causes of their irregularities.

> "The principal meteorological characteristics of the year 1873 were an excessive temperature, in Oude and the North-western Provinces more especially; an unusually low pressure of the atmosphere in the same region, and probably also in the south-east corner of the Bay of Bengal, while in Eastern Bengal pressure was persistently high; great unsteadiness in the winds, indicating the predominance of local causes in affecting the air currents, while the normal monsoon current from the south-west set in nearly a month later than usual, and ceased nearly a month earlier; lastly, a general deficiency of moisture in the atmosphere, as is betokened both by the hygrometric observations, the comparative absence of cloud, and the great deficiency of rainfall."

The usual characteristics of the Indian summer monsoon, based on the past seven years' observations, are thus stated:—

> "In ordinary years the winds of the south-west monsoon blow, on the one hand from the Arabian Sea, on the other hand from the Bay of Bengal *towards a line lying to the south of the Ganges*, at no great distance, and parallel to that river. A barometric depression begins to appear in or near this region in April, and by the time the rains set in in June it is well established; the pressure decreasing along it from east to west where this trough, as it may be termed, merges in the great barometric depression of the Punjâb and the Bikaneer Desert. To the south of this line the winds from the Arabian Sea blow across the Central Provinces, chiefly from the west. To the north of it, those from the Bay of Bengal, turning with the Gangetic Valley, blow in an opposite, or easterly, direction, their line of meeting being along this trough."

Bengal being thus dependent, as regards its rainfall, on the aërial current which blows from the Bay of Bengal up the valley of the Ganges, it is evident that whatever weakens this current or directs it to the northward will have a serious influence on the rainfall. Now, in 1873 the trough described above did not occupy the usual position to the south of the Ganges, but a position considerably to the north-west, in Oude and Rohilcund, immediately under the hills. A change in the direction of the wind necessarily followed this change in the position of the area of lowest atmospheric pressure; and in strict accordance with the now well-known relation of wind to pressure, there was an unusual prevalence of westerly winds over the greater part of Bengal during June and July, and the rainfall consequently was deficient.

The observations made in the Andaman and Nicobar Islands show the existence of a barometric depression over the south-eastern portion of the Bay of Bengal, the effect of which would be to deflect a large portion of the monsoon current of the Bay of Bengal towards Sumatra and the Tenasserim and Burmah coasts. Thus, then, the monsoon current, on which Bengal is dependent for its rainfall, was not only deflected northward from its usual track during 1873, but was also weakened in force by being partially drained away to the south-east in the direction of Burmah.

In the examination of the rainy seasons of 1868, 1869, and 1873, Mr. Blanford has the merit of first drawing attention to the existence of local and persistent variations of pressure, which appear as a local exaggeration or partial suppression of the great annual variation—the pressure remaining for many months, sometimes through two or more consecutive seasons, either higher or lower than the average, relatively to other parts of the country, over a more or less extensive track. It is to these persistent irregularities in the distribution of atmospheric pressure that the irregularities in the distribution of the rainfall must be ascribed, and it is to the further investigation, by future observations, of the characteristic feature of persistency in this class of barometric variations that we look with hope to the realisation of a great triumph awaiting meteorology, viz., the prediction, for some months in advance, of the general character of the coming seasons of India, and thereafter a gradual extension of the principle to other countries.

As regards the humidity, the only data of observation published in the Report are the dry-bulb observations. To these are added the *computed* values for the elastic force of vapour and the relative humidity. In future issues of the Reports we should recommend that the wet-bulb observations be also published. In a country of such extreme climates as India, it is eminently desirable to have the whole *observed facts* relative to the humidity before us, particularly since, from the present defective state of our hygrometric tables as regards dry hot climates, computed values can be regarded only as rough approximations. In estimating the state of the sky, a clear sky is entered as 10, and a sky completely covered with cloud as 0. It might be well in future to adopt the recommendation of the Vienna Meteorological Congress on this head, by which a clear sky is entered as 0, and a sky completely covered with cloud as 10. The number of days at the various stations at which "a measurable quantity of rain fell," are given in Table xxx. The exact amount of rain constituting a rainy day should in future be stated. In Great Britain only those days on which at least 0·01 inch falls are regarded as "rainy days." We are glad to see that Symons' gauges (5-in. diam.) are adopted—this being the gauge best suited for general introduction—and that the height is a foot above the ground.

We have long been convinced that for a first satisfactory scientific discussion of some of the more difficult problems of the science we must look for the data of observation to India, with its splendid variety of climates, exposures, and abrupt mountain ranges and isolated peaks. The chief of these questions are, the variations in the daily march of temperature as dependent on season, latitude, height, and situation, both maritime and inland; the hourly barometric fluctuations (of which so little is really known), particularly as influenced by strong insolation, vapour, cloud, aqueous precipitation, and height either on extended plateaus or on hills rising abruptly from the plains; and the vital question of atmospheric humidity, to put which on a proper footing as regards hot dry climates, laboratory experiments being all but worthless, recourse must be had to extensive observations and experiments conducted under such conditions as are presented by the scorching climate of the Punjâb. In the further development of Indian and general meteorology, the establishment of a Physical Observatory in the Punjâb is urgently called for, as being, in truth, indispensable for the prosecution of these and other physical researches.

OUR BOOK SHELF

A Year's Botany, adapted to Home and School Use. By Frances Anna Kitchener. Illustrated by the Author. (Rivingtons: London, Oxford, and Cambridge, 1874.)

THIS unpretending little book is one that is sure to find its way wherever Natural Science is taught in the only way in which it is worth teaching, as a training for both the observing powers and the reasoning faculties. The greater part appeared originally in the *Monthly Packet*, and has been reprinted with additions at the request of friends more discriminating than is usually the case under such circumstances. We know of no book which we could more safely and confidently place in the hands of young people as their first guide to a knowledge of botany. The illustrations are from drawings from nature by the authoress, and are a pleasing change from those which have already done duty in so many text-books.

The following sentence, from the first chapter, illustrates the mode in which the writer conveys her instruction:—"But first I must beg that my readers will give me a fair trial; that they will pick the flowers described, and examine them *while* they read the description; and that they will trace every law, arrangement, and peculiarity in their living illustrations. Sometimes these may not be seen at the first glance, or even in the first specimen, but they must pick fresh flowers, look and look again, and *take nothing upon trust*, remembering that one of the chief lessons botany has to teach is how to use both eye and hand." Several typical flowers are then taken—the buttercup, wall-flower, cucumber or vegetable marrow, gorse, garden-pea, and primrose, and the various parts of each described in ordinary language, without the use of any technical terms. To these succeed separate chapters "On Flowers with Simple Pistils," "On Flowers with Compound Pistils," "On Flowers with Apocarpous Fruits," "On Flowers with Syncarpous Fruits," and "On Stamens and the Morphology of Branches." To each chapter is prefixed a list of specimens which will be required to enable the student to follow for himself the writer's analysis; the descriptions are given in an extremely easy and lucid style, a few of the commonest scientific terms—but as few as possible—being gradually substituted for the colloquial English phrases at first employed. A sufficient acquaintance having then been obtained with the morphology of the more conspicuous organs, and their functions at the same time explained, the phenomena of nutrition, respiration, and fertilisation, and the structure of tissues, are described in chapters "On Fertilisation," "On Seeds," "On Early Growth and Food of Plants," "On Wood, Stems, and Roots," and "On Leaves." A chapter is then given to classification, to which is appended some useful tables of the characters of the more important orders; and this is followed by two or three chapters devoted to a few of the more important natural orders, and intended to serve as an introduction to the mode of naming plants. The most commonly used technical terms which have not been employed in the work itself are explained in an appendix, in which the wants of students preparing for the University Local Examinations have been kept in view.

The mistaken plan on which many botanical text-books have been compiled is so largely answerable for the horror in which the subject is held by candidates for examination who endeavour to cram facts and technical terms in an incredibly short space of time, without an attempt at practical work, and in the end fail miserably, that we cordially welcome an attempt to place the study on its true footing. We entirely concur in the view of the writer, that to this false method is due the fact that "Botany is so often stigmatised as a dry, uninteresting study;" an opinion which would speedily disappear were her mode of instruction in general use in the family and the school. Mrs. Kitchener's "A Year's Botany" seems to us admirably adapted for the purpose which she had in view in publishing it, and we heartily desire for it a large circulation.

A. W. B.

Dental Pathology and Surgery. By S. J. A. Salter, F.R.S. (London: Longmans, Green, and Co., 1874.)

THERE is much in dental surgery besides the simple extraction of teeth, and it is to the consideration of the science of dental pathology that Mr. Salter devotes most of the work under notice. The introductory chapters treat shortly of structure and function, development being left out of consideration. An excellent diagram explains the relation of the tongue to the different parts of the mouth during the pronunciation of the various letters of the alphabet, which latter is arranged on a physiological basis, dependent on the situation of the point of closure by which the sound is produced, upon the completeness or incompleteness of the closure, and upon whether the breathing is soft or aspirate. To the purely physiological student the chapter on irregularities in the position and union of contiguous teeth will be of particular interest; as will the instances given of defects in their number depending on hereditary causes, and on alopœcia; to which we may add the peculiar deficiency always connected with the excessive development of hair over the face, as in the Russian man and child who so recently visited this country. The differentiation off from pure surgery of a class of tumours which, before Mr. Salter's investigations, were considered to belong to the bones themselves, and which, as odontomes, are now known to be composed of secondary dentine, will be specially instructive to the pathologist, as will the question of reflex nervous phenomena, such as partial paralysis and blindness, from the irritation of a diseased tooth. A full and very instructive account is also given of "phosphorus disease," which attacks in so painful a manner the manufacturers of lucifer matches, and which can be so completely obviated by the employment in their construction of red instead of ordinary phosphorus, because the former does not give rise to the formation of acid fumes when exposed to the air, and therefore does not attack the mouth and teeth. There is one subject on which we have looked, but in vain, through this volume for information: it is for the explanation of how it is that tooth-disease and civilisation so unfortunately go hand in hand. The work will be found of special interest to all tudents of surgery.

LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

Deep-sea Researches

WHEN Prof. Wyville Thomson published his recent volume giving the results of the deep-sea researches conducted by himself and his colleagues, Dr. Carpenter, Mr. Jeffreys, and others, he also gave a sketch of the history of the subject; but he made no mention of my memoir on the Microscopic Organisms of the Levant Mud, published in 1847 in the Transactions of the Literary and Philosophical Society of Manchester, though this memoir had been referred to from time to time by Dr. Carpenter, Messrs. Parker and Rupert Jones, and others, and was, next to Ehrenberg's discovery of the microscopic structure of chalk, the tarting-point of all these deep-sea investigations. It was the irst to call attention to the existence of foraminiferous deposits n the sea, and to insist upon the organic origin of *all* limestones except a few freshwater Travertins, in opposition to the theory of chemical deposits that had previously been advocated in the works of Phillips and other geologists. I do not care very much bout these questions of priority of observation, but since Dr. Wyville Thomson's article in NATURE, vol. xi. p. 116, dwells argely upon another point, which was also brought prominently orward in my memoir, I think it worth while preventing a repeition of the oversight, because the two subjects referred to, viz. he foraminiferous origin of calcareous deposits, and the subsequent modification of such deposits by the agency of carbonic cid gas, now prove, as I long ago insisted that they would do, two of the most important factors in the solution of the problem of he nature and origin of deep-sea deposits. Dr. Wyville Thomson, in the article in question, points out that extensive reas of the deep-sea bottom are now occupied by a reddish earth, nd he has arrived at the conclusion that this earth is a residue left after all the calcareous Globigerinæ and other such elements have been removed by the solvent action of carbonic acid accumulated in these deep waters. In my memoir I arrived at the ame conclusion from the study of the marine Tertiary deposits, ontaining Diatomaceæ, of Bermuda, Virginia, and elsewhere. I may perhaps be permitted to republish the following extracts rom that memoir, since it is not now readily accessible to all the umerous naturalists who are interested in this question:—

"In the recent deposit of the Levant we have generally an dmixture of calcareous and siliceous organisms. In some localities the latter are more sparingly distributed than in others; in few instances they are almost entirely absent. The same dmixture occurs in the recent sands from the West Indies. The oft calcareous mud from the bottom of the lagoons of the Coral slands contains a considerable number of similar siliceous orms, and corresponding results have been obtained in most of he marine sediments from various parts of the globe, examined y M. Ehrenberg.

"On the other hand, the infusorial deposits of Bermuda and Virginia are altogether siliceous. Not one calcareous organism xists. The siliceous forms comprehend the majority of those which I have described from the Levant, many of them being not only *similar* but specifically identical, and the manner in which they are grouped together in these distant localities indicates something more than mere accident. Indeed, we want nothing but the calcareous structures to render these Myocene strata perfectly analogous to those now in process of formation both in the Mediterranean and in the West Indian seas. Are these siliceous deposits, so void of any calcareous organisms, still in the condition in which they were originally accumulated? or were they once of a mixed character, like those of the Levant, having been subsequently submitted to some chemical action which has removed all the calcareous forms, leaving only the siliceous structures to constitute the permanent stratum? I am disposed to adopt the latter opinion, for several reasons."

After showing the resemblance between the residue left after treating certain substances with nitric acid, and the diatomaceous deposits, I proceed to say:—

"Such deposits, in these present conditions, stand out as anomalies in the existing order of oceanic phenomena, and have nothing resembling them except the local freshwater accumulations which occur in various places. Between these, however, no real analogy exists. It must not be forgotten that the Virginian deposit can be traced for above two hundred miles; and, being marine, would doubtless be mixed up with such marine products as were likely to occur along so extended a line. The only recorded instance with which I am acquainted, that exhibits the slightest resemblance, is furnished by M. Ehrenberg, in his examination of materials brought home from the south pole by Dr. Hooker. Some pancake ice, obtained in lat. 78° 10', long. 162° W., when melted, furnished seventy-nine species of organisms, of which only four were calcareous Polythalamia, the remainder being all siliceous. But even this example, remarkable as it is, does not supply us with any real parallelism. The deposits in question have never yet exhibited a single example of a calcareous organism."

After referring to the European greensands, I continue:—

"Nature furnishes us with an agent quite equal to the production of such effects as we are at present acquainted with. This is carbonic acid gas in solution in water. Mr. Lyell has already availed himself of the instrument to account for the subtraction of calcareous matter from imbedded shells, as well as for some of the changes that have taken place in the structure and composition of stratified rocks . . . It is easy to conceive that whilst these strata were in a less consolidated state than at present, they might be charged with water containing carbonic acid gas. This would act as a solvent of the organic atom of lime until the acid was neutralised." . . .

After venturing upon these conclusions in 1847, not as mere speculative guesses, but as the deliberate result of a long series of investigations carefully worked out, I need scarcely say how intense was the interest with which I read Dr. Wyville Thomson's observations, which so thoroughly sustain and confirm the accuracy of mine. My conclusions were wholly derived from the microscopic observations of earths and rock specimens which I compared with the few examples of foraminiferous ooze with which I was then familiar. The *Challenger* researches now show us how extensively the conditions described in my memoir have prevailed; a fact which could not have been ascertained before the machinery for deep-sea exploration attained to its present perfection. But having arrived at them in a decided or definite manner when the materials for doing so were much more scanty than they now are, and when no one except myself and the late Prof. Bailey of West Point were giving much attention to the subject, I think I am justified in wishing the fact to be placed on record.

Owens College, Dec. 12 W. C. WILLIAMSON

Origin of Bright Colouring in Animals

THE origin of the bright colouring of flowers, through natural selection effected by insects, appears to me one of the strongest points of the Darwinian theory. But I think the origin of the bright colouring of many animals, especially birds and insects, is on the contrary one of the greatest of its difficulties. Darwin accounts for it in most cases by sexual selection—the most beautiful males being the best able to obtain mates and to leave offspring.

In the way of this theory there are three very serious difficulties, which I think have not been dwelt on as they deserve.

1. Before special coloration could arise as a specific character, the colours must have been variable; for selection can work only when it has variation to work with, and it appears incredible that such a cause as sexual selection could ever give them any great degree of fixity. But the bars and spots on the wings of birds and butterflies are, as a rule, perfectly definite, and not more variable within the limits of the same species than any other part of the organism. This difficulty does not apply in the same degree to the origin of the coloration of flowers through

natural selection by insects, because the spots and streaks of flowers are much less sharply defined.

2. Why is ornamental colouring, as a rule, confined to the male? If the love of beauty is an animal instinct, why, on Darwinian principles, is not beauty developed in the females, the most beautiful females being the most likely to obtain mates and leave offspring? I speak chiefly of birds.

3. Is there any reason to believe that the female has any choice or power of selection whatever? I think that what evidence we have goes to prove that she is passive: and certainly this opinion is supported by the very general fact of the males fighting for the possession of the females.

If the love of beauty is an animal instinct, then Darwinian principles would require that the struggles of the males for the possession of the most beautiful females should develop beauty in the females by natural selection. But we see that the contrary is what takes place—beauty is developed in the male, the fighting sex.

Were a Darwin among birds to watch the ways of the human race, he would probably feel certain that the love of dress and ornament among women is altogether due to a desire to become attractive to men; and he would think those naturalists unsatisfactory, and perhaps mystical, who guessed the truth, that the love of ornament is a natural and healthy human instinct, not confined to either sex or to any age, but stronger in youth than in age, and stronger in woman than in man.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim

Psychology of Cruelty

THERE is a passage in Mill's recently published essay on "Nature" which well merits the attention of evolutionary psychologists. It is as follows:—"Again, there are persons who are cruel by character, or, as the phrase is, naturally cruel; who have a real pleasure in inflicting, or seeing the infliction of pain. This kind of cruelty is not mere hardheartedness, or absence of pity or remorse; it is a positive thing; a particular kind of voluptuous excitement. The East, and Southern Europe, have afforded, and probably still afford, abundant examples of this odious propensity." (Page 57.)

Now, I think that this "hateful propensity" is of more common occurrence than even Mr. Mill here gives it credit for. Indeed, I doubt whether anyone is entirely devoid of it, although, of course, everyone who is sufficiently advanced in moral culture to admit of the subordination of the baser instincts to the higher, has been more or less successful in "starving it by disuse." I believe, in short, that this propensity must be regarded as one of the primary instincts of our nature, although, like other instincts, it varies in its original intensity in different individuals, and is further differentially modified by the influences of education. The nature of this instinct is well expressed by Mr. Mill in the above-quoted phrase, "a particular kind of voluptuous excitement." This, I think, supplies the reason why it is, as a rule, of stronger development in men than in women, and why, as Mill observes, it is of most frequent manifestation in warm climates. It is also worth observing, that although thus akin to the amatory passion, it is of much earlier growth in the life-history of the individual. Indeed, childhood and youth are, in civilised society at least, the seasons when its presence is most conspicuous; in consequence, I suppose, of the restraining power which reflection subsequently brings to bear upon it not as yet having been called into action.

To explain the origin of this instinct by the evolutionary psychology is, I believe, impossible in the present state of our knowledge; for there is no period in the history of the race at which it is conceivable that the latter should have derived any benefit from the birth and development of this peculiar passion. Yet I believe it is now in some persons, were it permitted to assert itself, of even more intensity than is the highly beneficial inclination to which, as we have just seen, it is so strangely allied. To refer to the striking similarity of this passion in man to that which is manifested by monkeys, is not of course to explain its origin; but I am quite sure it is in the monkeys that this explanation is to be sought. Everyone knows that these animals show the keenest delight in torturing others simply for torturing sake, but everyone does not know how much trouble an average monkey will put himself to in order that he may gratify this taste. One example will suffice. A naturalist who had lived a long time in India told me that he has not unfrequently seen monkeys feigning death for an hour or two at a time, for the express purpose of inducing crows, and other carnivorous birds, to approach within grasping distance; and when one of the latter were caught, the delighted monkey put it to all kinds of agonies, of which plucking alive seemed to be the favourite.

As I am not aware that any other animal exhibits this instinct of inflicting pain for its own sake—the case of the cat with a mouse belonging, I think, to another category—I believe, if its origin is ever to receive a scientific explanation, this will be found in something connected with monkey-life.

PHYSICUS

Migration of Birds

YESTERDAY and to-day (17th and 18th inst.) continuous flights of migrant birds, chiefly fieldfares and redwings, have passed over this place in one uniform direction, from east to west, turning inland to the north-west, as though unwilling to cross Poole Harbour. The procession, so far as it attracted my own notice, began with daybreak of the 17th, and was so rapid and continuous all that day that enormous numbers altogether must have passed over us. Close flocks would come, and then a continuous flight of stragglers, but all in one and the same direction, and with little deviation from a well-defined aërial pathway, as though keeping some visible high-road. Yesterday the flight was down the wind; this morning against it; and although the flight was low and the birds seemed tired, none alighted in this neighbourhood. Whence did they come, and whither are they bound—east or west of this place? Can any of your readers say?

H. C.

Bournemouth, Dec. 18

The Potato Disease

IN his letter of last week, Prof. Dyer states that his main object in his previous letter was "to claim for a distinguished English botanist credit for work done by him thirty years ago." In his previous letter this work is defined by Prof. Dyer to be the discovery by the Rev. M. J. Berkeley of the fact that the potato disease was due to the attacks of a parasitic fungus. As the service, with which botanists are familiar, that Mr. Berkeley has rendered in this matter, is the publication and advocacy in this country of the discovery previously made by Montague and others, with a few additional observations of his own, Prof. Dyer would confer a favour on his fellow-botanists by giving a more exact reference to the records which he is so anxious should be duly recognised.

INQUIRER

HELMHOLTZ ON THE USE AND ABUSE OF THE DEDUCTIVE METHOD IN PHYSICAL SCIENCE[*]

SINCE the translation of the first part of this volume was published, its whole scientific tendency, and specially a series of individual passages in it, have been subjected to a more than vigorous criticism by Mr. J. C. F. Zollner in his book "On the Nature of Comets." I do not think it necessary to answer expressions of feeling in reference to personal characteristics of the English authors or of myself. I have as a rule considered it necessary to reply to criticisms of scientific propositions and principles only when new facts were to be brought forward or misunderstandings to be cleared up, in the expectation that, when all data have been given, those familiar with the science will ultimately see how to form a judgment even without the discursive pleadings and sophistical arts of the contending parties. If the present treatise were intended only for fully educated men of science, Zöllner's attack might have been left unanswered. It is, however, essentially designed for students also, and as junior readers might perhaps be misled by the extreme assurance and the tone of moral indignation in which our critic thinks himself justified in expressing his opinions, I consider that it would be useful to answer the attacks made on the two English authors, so far as may be necessary to enable the reader to make out the truth by considering the matter for himself.

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[*] Translated by Prof. Crum Brown from Helmholtz's preface to the second part of the German edition of Thomson and Tait's "Natural Philosophy," vol. i.

Among the scientific investigators who have especially directed their efforts towards the purification of physical science from all metaphysical infection and from all arbitrary hypotheses, and, on the contrary, have striven to make it more and more a simple and faithful expression of the laws of the facts, Sir W. Thomson occupies one of the first places, and he has consciously made precisely this his aim from the beginning of his scientific career. This very thing seems to me to be one of the chief services rendered by the present book, while in Mr. Zöllner's eyes it forms its fundamental defect. The latter would like to see, instead of the "inductive" method of the scientific investigator, a predominantly "deductive" method introduced. We have all hitherto employed the inductive process to discover new laws, or, as the case may be, hypotheses; the deductive to develop their consequences for the purpose of their verification. I do not find in Mr. Zöllner's book a distinct declaration by which his new mode of procedure may be distinguished from that generally followed. Judging from what he aims at as his ultimate object, it comes to the same thing as Schopenhauer's Metaphysics. The stars are to love and hate one another, feel pleasure and displeasure, and to try to move in a way corresponding to these feelings. Indeed, in blurred imitation of the principle of Least Action (pp. 326, 327), Schopenhauer's Pessimism, which declares this world to be indeed the best of possible worlds, but worse than none at all, is formulated as an ostensibly generally applicable principle of the smallest amount of discomfort, and this is proclaimed as the highest law of the world, living as well as lifeless.

Now, that a man who mentally treads such paths should recognise in the method of Thomson and Tait's book the exact opposite of the right way, or of that which he himself considers such, is natural; that he should seek the ground of the contradiction, not where it is really to be found, but in all conceivable personal weaknesses of his opponents, is quite in keeping with the intolerant manner in which the adherents of metaphysical articles of faith are wont to treat their opponents, in order to conceal from themselves and from the world the weakness of their own position. Mr. Zöllner is convinced "that the majority of the present representatives of the exact sciences are wanting in a clearly conceived intelligence of the first principles of the theory of perception" (p. viii.) This he tries to confirm by reference to supposed gross errors made by several of them.

Here then, of course, Messrs. Thomson and Tait must submit to the ordeal. They have, in paragraphs 381-385 of the present book given expression to their conviction as to the right use of scientific hypotheses. They, in paragraph 385, find fault with hypotheses which are too remote from observable facts, and select, as instances of their injurious influence, naturally only such as, by their extensive diffusion and by the authority of their originators, have been really influential. In this connection they place side by side the law of electrical action at a distance propounded by our countryman, W. Weber, and the emission theory of light as worked out by Newton. This juxtaposition is the best proof that the English authors had nothing in view that should wound a healthy German national feeling.

It has not as yet, I believe, come to such a pass in Germany—it is to be hoped it never will—that hypotheses may not be criticised, whatever be the eminence of their propounders. Should it actually ever come to this, then indeed Mr. Zöllner and his metaphysical friends would be justified in bewailing, or it may be in triumphing over, the destruction of German science. No one can be blamed for having advanced a hypothesis which the further progress of science shows to be inadmissible, just as it is no discredit for one who has to seek his way in an entirely unknown country to take the wrong road for once, in spite of his utmost attention and consideration. It is further obvious that whoever regards as erroneous a hypothesis which has captivated the minds of a large number of scientific men must necessarily hold that it, for the time being, injures and retards the progress of science, and will be justified in expressing this opinion, if it becomes his duty to advise, according to his matured conviction, a student as to the path he should follow.

One of the arguments which Sir W. Thomson has adduced to prove the inadmissibility of Weber's hypothesis, is that it contradicts the law of the conservation of energy. I was also obliged to bring forward the same allegation somewhat later in a paper [*] published in the year 1870. Now Mr. Zöllner, relying on the authority of Mr. C. Neumann, has assumed that this allegation is erroneous. On the contrary, Weber's law seems to him to be another universal law of all forces in nature (it is not explained how these different universal laws agree with one another), and he devotes twenty pages of his introduction to the purpose of airing his indignation at the intellectual and moral dulness of those who attack it. Mr. Zöllner will, no doubt, since then, have become aware that it is at least imprudent, without other support than the authority of one of the parties in a scientific debate, to try to help the other by libellous remarks, apart from the consideration that by such means one can contribute nothing to the settlement of the dispute, but perhaps much to its embitterment. Mr. C. Neumann was himself a party in this affair; my objections applied also to the theory of electrodynamic actions, to which he then adhered. He has since then given up this theory. He and also Mr. W. Weber thought that they could maintain the original theory of the latter, if they took into consideration the co-operative action of molecular forces in the case of closely approximated electrical masses. I then, in my second contribution to the theory of electrodynamics,[†] pointed out that the assumption of molecular forces does not stop the leak in Weber's theory. In the meantime Mr. C. Neumann himself, before he knew of my second paper, had given up the attempt to found a theory of electrodynamics upon Weber's law, and had tried to devise a new law for that purpose.

And here, in reference to the emphatic way in which our opponent speaks of the deductive method, I would make the following remarks on this example:—According to the view hitherto held by the best scientific investigators, the deductive method was not only justified, but indeed *required*, when the admissibility of a hypothesis was to be tested. Every legitimate hypothesis is an attempt to establish a new and more general law which shall include under it more facts than those hitherto observed. The testing of it consists in this, that we seek to develop *all* the consequences which flow from it, in particular those which can be compared with observable facts. I should therefore imagine the first duty of those who would support Weber's hypothesis to be, among other things, to see whether this hypothesis can explain the most general fact, that electricity, when no electromotive forces act on it, remains at rest in all electrical conductors, and is therefore capable of continuing in stable equilibrium. If Weber's hypothesis implies the contrary of this, as I have attempted to prove, then the next thing to be done would be to look out for such a modification of it as would render stable equilibrium possible in the largest as well as in the smallest conductors. According to my view, this would have been a right course, and the one required by the deductive method, but not to call a halt when inconvenient consequences appear, and excuse oneself with the plea that the right differential equations for the motion of electricity in accordance with Weber's law had not yet been discovered. And if some one else takes this trouble, then he who considers himself a representative κατ' ἐξοχήν of the deductive method should applaud him, instead of charging him with impiety, even if the results of the inquiry should turn out to be inconvenient for the Icarus flight of speculation.

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[*] "Ueber die Bewegungsgleichungen der Elektricität für ruhende leitende Körper." Borchardt, *Journal für Mathematik*, Bd. 72, 75.

[†] Borchardt, *Journal für Mathematik*, Bd. 75.

As Mr. Zöllner does not put himself forward as a mathematician—on the contrary, informs us on pages 426 and 427 of his book that the too frequent use of mathematics cramps the conscious activity of the understanding and is a convenient means of satisfying vanity; and besides, in many passages, constantly repeats his expression of contempt for those who think they can refute his speculations by pointing out mistakes in differentiation and integration —we ought not to judge him too severely in the matter of Weber's law. No doubt it is scarcely reasonable for one who thinks himself entitled to be shaky in his mathematics, to take upon himself to pronounce upon matters which can be decided by mathematical investigation only. His "Theory of Comets," which may surely be regarded as in his opinion a model specimen of how the right methods are to be employed, gives, besides this, other much more popular examples of the same peculiar way of using or not using deduction, examples the consideration of which may be reserved for another more suitable opportunity.

(*To be continued.*)

MOVEMENTS OF THE HERRING

THE mysterious disappearance of the body of herring which used to frequent Loch Fyne has directed renewed attention to the natural history of that fish. This is now the second time that the shoal of herrings which made Loch Fyne its *habitat* has deserted that celebrated sheet of water. No scientific opinion has yet been given as to the cause of this disappearance. A number of fishermen, resident on the Loch, say the herrings have been frightened away in consequence of persons fishing for them with a trawl net—which is, of course, nonsense; but not more nonsensical than the reasons assigned for the desertion by herring of other localities. As the so-called trawl-fishing of Loch Fyne (the net used is in reality a seine) was not in existence when the fish forsook the Loch on a former occasion, and were absent for a period of six years, the opinion of these men may be passed over as unworthy of serious consideration. Writers in the local newspapers, while inclined to favour the opinions of the drift-net men, that is, those who assert that the trawl-fishers have scared away the fish, also ask whether the spawning-beds may not have been in some way interfered with, and whether the body of fish frequenting the Loch may not from some unknown cause have departed before depositing their seed. If so, in what year would that occur? In other words, how long is it before the herring spawn of any given year comes to life, and at what period will the fish then born become reproductive?

These are events in the natural history of the herring, the dates of which have not yet been authoritatively settled. They are points, indeed, which have not yet been decided as regards any of our fish, except, *perhaps*, the salmon (*Salmo salar*), which has been nursed into life under a system that may be called artificial, that admitted of the young fish being watched, and their growth traced stage by stage, by means of certain signs and marks. It is thought that we may speak of the natural history of the salmon with more confidence than that of any of our other food-fishes. It is unfortunate that their studies of the natural history of the herring have not yet enabled naturalists to determine with exactitude how long it takes that fish to come to maturity.

Most varied opinions have been given on these points of herring life. Some persons have even gone the length of asserting that *Clupea harengus* and its congener *Clupea pilchardus* are able to perpetuate their kind within a year of their birth; even at the age of ten months! It has also been asserted that a herring is able to breed twice a year. Other opinions have been given, which assign to the herring a much longer period of growth, namely, that it requires from three to five years to reach maturity. Yarrell, again, and also Mitchell, think that it becomes reproductive in so short a period as eighteen months. What we may hold that we really do know is, that the eggs of the herring can be hatched within twenty days after their contact with the milt of the male fish. This has been proved by visiting the spawning places of the animals. On one visit all was spawn, everything that came in contact with the spawning-beds being covered with the seed of the herring; at the next visit, a fortnight after, the spawn was all gone; it had become vivified—and in proof of the fact, young herrings could in two or three weeks after be found in shallow places varying from an inch to two and even three inches in length. The probable time between the spawning of the fish and the fry reaching the dimensions named would be about forty days. How fast the young ones grow after that has not been authoritatively ascertained. It is thought, however, that if young herring reach the size of, say two-and-a-half inches, in forty days, it is not unreasonable to expect them to continue growing at the same ratio.

In the case of *Salmo salar*, the period necessary for the incubation of the egg has been determined beyond dispute. It ranges from 90 to 130 days. The growth of the young fish, after a time, if those who have watched it have not been deceived, is very rapid. At first, however, the salmon grows very slowly. A salmon hatched in March last may still be a very tiny animal, even after it is twelve months and in some cases two years old. In a year, however, it may be four or five inches long, and ready to migrate to the sea. There is a curious feature in the natural history of the salmon, the law of which has never yet been discovered—it is a riddle, in fact, even to the most scientific observers: only one half of the salmon of any particular hatching develop into what is called the *smolt*, or migratory stage, at the end of about twelve or fifteen months from the time of their being hatched. The other moiety of the brood does not seek the sea or take on the migratory dress till the expiry of a little over two years from the time of birth! One half of the fish, therefore, will at one and the same time be tiny creatures, about three inches long, whilst the other moiety will be five inches in length, and of corresponding girth; but these dimensions, it must be confessed, show no great rapidity of growth. Indeed, it is not till after the salmon proceeds to the sea that its growth becomes at all rapid; but, notwithstanding this rapidity, it must, we think, be a considerable number of years before a salmon can attain to the weight of fifty or sixty pounds; although the smolt, it is affirmed by those who have watched it, returns as a grilse to its native waters in about three months, its size and weight being very largely increased.

The herring, as we all know, is a fish that never attains to any great size, and the weight of which may be counted in ounces. The question to be answered is this: Do small fish grow to maturity quicker than large ones? It has been asserted, in some quarters, that the herring grows quite as rapidly as the smolt does *after* it reaches the salt water, and the rate of growth there appears magical, when contrasted with its slow progress during the first year of its existence, or it may be, as has been already explained, the first two years. We are not, however, without a certain kind of proof of the rate at which the herring grows, which is better than reasoning analogically. It is quite fair to conclude that if herrings attain a size of about three inches within forty days or so of their birth, they will attain their full dimensions within a year. It is known of herring, by means of personal observation, that from the time the roe or milt begins to develop itself, that is, when they become *maties*, no very long time elapses till they are ready to spawn: ten weeks has been estimated as about the time the herring takes to grow from a "matie," or fat fish, to a spawning herring.

The most contradictory accounts of the time at which herrings spawn have been published by various inquirers. Much of this confusion results, no doubt, from the fact that the herring is somewhere engaged in fulfilling this function of its life during nearly every month of the year. There are, it is thought, distinct races of this fish constantly coming to maturity and spawning at suitable times with the instinct of keeping up the breed. Thus, at Wick, on the Caithness coast, where there is still a great fishery carried on, although it is evidently now on the wane, herrings came to maturity and were ready to spawn in July. At one time large numbers of these (July) herrings were caught; indeed, some economists say too many were caught, and that in consequence the reproductive strength of the shoal was so impaired, or its economy so deranged, that it became exhausted. At any rate, few herrings are now taken in July at Wick. The great August shoal is being also over-fished, and symptoms are not wanting in the violent fluctuations which occur in the "takes," that it too will in time become unproductive. Herrings are found in the Firth of Forth ready to shed their spawn in the months of December, January, and February, and during these months young herrings and sprats (*Clupea sprattus*), are found mixed in the shoals which are fished at that period of the year. The question of where these schools of young fish go to whilst they are growing naturally presents itself. But who can answer it? The theory of the migration of the herring from and to the seas within the arctic circle has been long exploded, it having been established, it was thought, beyond cavil, that it is a native of our own seas: at all events, that it comes close to certain parts of the British sea-coasts to deposit its spawn. It is at that period of its life that we become familiar with the herring, and that is the time at which it can be most economically captured. Herrings are seen at that period of their lives in prodigious numbers; in fact, they lie in tiers on a favourite spawning ground, covering several square miles of sea-bottom. If all the parks of London were united together into one great space of ground, it would not nearly represent the width and length of a shoal of herrings engaged in spawning!

It has been asserted that herrings aggregate and segregate, but proof of this fact in their natural history is lacking. Almost immediately after the spawn has ripened into life, the tiny herrings are seen crowding together on the most shallow places of the coast, where they are safe from the attacks of larger fish, which would assuredly prey upon them if they frequented the deeper water. Now, if these fish separate, when do they do so? because, if they come to maturity, as is said, within a year, they have little time to live apart. If they go out to sea, how far do they go? It is a fact that at the time they are caught they are at first taken at a considerable distance from land. The writer has been out as far as twenty-five miles from the shore without finding a trace of the shoal; but within ten days or so the fish were found within a radius of ten miles of the port from which he had sailed in search of them, and they gradually came nearer and nearer, being often caught within two miles of the land. Although the fish of particular localities have such distinctive marks upon them as to render it easy to distinguish them, certain persons have again mooted the idea of the herring being a migratory animal, and that a great fish-shoal travels from the north to the south. A writer in a recent number of the *Scotsman* newspaper speaks of a vast shoal of herrings having arrived at Wick, then of its passing Fraserburgh and Peterhead; next, of its being found at Dunbar and Eyemouth; then on the coast of Northumberland; and finally, he tells us, it will be found at Yarmouth, on the coast of Norfolk! What else is this but a revival of a portion of the old myth? The shoal must be constantly finding out new places to visit, and must also be deserting places where it used to call; it must also tell off brigades to spawn at different localities; otherwise, all that we have learned about the natural history of the herring during the last few years is imaginary. Any novice, almost, could distinguish a herring taken from Loch Fyne, when placed side by side with a herring caught off the bay of Wick. Fraserburgh, one of the places cited by the writer in the *Scotsman*, has only risen to importance as a herring port within the last ten years; close upon seven hundred boats were this year engaged in the fishery, whilst in 1864 there was not much above a fourth of that number. At Fraserburgh, and two or three little fishing stations which adjoin it, 181,000 crans of herrings were captured this year, and these fish would be of the value of about 300,000*l*. The capture by the boats fishing from Peterhead—also on the Aberdeenshire coast—this season would not be of less value than a quarter of a million pounds sterling. But whilst these Aberdeenshire ports are rising into notice as great centres of the herring fishery, other ports are declining. Wick, which used to be the capital of herring fishery enterprise, is now on the decline as a curing station. Why? For the simple reason, it may be presumed, that the owners of boats do not find it profitable to fish at that port. At one time as many as 1,200 boats used to fish for the Wick curers, but the number at work this year was five hundred less! Such a falling off is very striking, and goes a long way to prove that it is possible to "over-fish" the herring, or at least so to derange the economy of the shoals as to render them in time unproductive. It is only reasonable to argue that with the largely augmented drifts of nets increased quantities of herring ought to be captured, but it is being annually demonstrated that such is not the case, and that to keep up present supplies and provide for the supply demanded by an exigent and increasing population, more boats and still more extensive drifts of nets are required.

Even very young fishermen have seen the rise and decline of important seats of the herring fishery, apparently from the over-fishing or derangement of the shoals. It will be instructive to note what occurs in future to the Wick fishery, because, only a few years ago, it was the greatest herring-curing station in the world, whilst next year there is every probability of its being only a fourth-rate fishing port. The fishermen will naturally go where they can take their prey with the least possible trouble, and where the fishery is more regular than it has been during late years at Wick, where most of the fish have been taken by a few of the more fortunate fishermen, and many of the boats had to return morning after morning "clean." The boats fishing at Fraserburgh this year took each an average of 220 crans of herrings, and all of them were tolerably well fished; whilst the Wick boats only averaged ninety-four crans, the fishing being even more partial than usual. The further development of the fishery at Fraserburgh, Aberdeen, and Peterhead, which extends over a space of about forty miles, will be anxiously watched. The shoal or shoals which are yielding such wealth to the fishermen of these ports must be prodigious in size and wonderfully productive; let us take note how long they last, and keep a correct tale of what they yield. The run upon them for the next two or three years will only be limited by the accommodation which the harbours can give to the boats and the ground which can be allotted to the curers. The movements of the herring become yearly more interesting, and we cannot be too well informed in regard to them.

THE TRANSIT OF VENUS

THE following telegrams have been received by the *Times* since our last issue.

"*Melbourne, Dec.* 11.—The American Expedition in Tasmania experienced unfavourable weather for their observations of the Transit of Venus."

"*Sydney, Dec.* 10.—The Transit observations here proved satisfactory."

"*Berlin, Dec* 17.—A telegram has been received from the German Astronomical Expedition at Tschifu, in North-eastern China, announcing that the observation of the Transit of Venus was quite successful. The observation of the contact, the heliometer measurement, and the photographs succeeded splendidly. The expedition was admirably supported by His Imperial Majesty's ship *Arcona*."

From Major Palmer, Christchurch, New Zealand:—

"English, nothing valuable anywhere—clouds. Americans got ingress, and photographs till near third contact. Nobody egress."

From Mr. Todd, Adelaide:—

"Transit of Venus.—Ingress cloudy. Egress well observed. Contacts 34434, 3475. (Probably 3h. 4m. 43·4s., and 34m. 7·5s. Adelaide mean time, for internal and external contacts.) No black drop."

From Vienna:—

"According to a telegram received by the Imperial Academy of Sciences from Drs. Weiss and Oppolzer, who went to observe the Transit of Venus at Jassy, the observation of external contact at the moment of the exit has succeeded. As they had time to fix the exact longitude and latitude of their point of observation, they obtained reliable data for calculation. The longitude was determined by telegraphic time signals with the Observatory in Vienna. As Jassy lies on the limits of the line where the phenomenon was visible, they attribute some importance to their observations."

Through Reuter's agency:—

"*Pekin, Dec.* 9.—The French astronomical party, under the direction of M. Fleuriais, succeeded in observing the first and second contacts. There was a slight black ligament. Photographs were taken. The weather was slightly hazy."

It will be seen that the news from New Zealand is of a most serious character, so far as the English scheme of observation is concerned. In fact, unless the French, Germans, and Americans have secured observations, the Delislean attack, so far as egress is concerned, has failed altogether. We shall postpone any further remarks till next week, as in the interval some information may be received from the stations to which we have referred.

NOTES

WE are informed that the Council of the Royal Society has appointed a Committee to consider the means of securing observations of the total eclipse of the sun in April next, to which they attach great importance.

PROF. CLERK-MAXWELL, F.R.S., has promised to give a lecture at the Chemical Society on Feb. 18 next, "On the Dynamical Evidence of the Molecular Constitution of Bodies."

THE *Times* states that Prof. Huxley is to undertake the duties of the Chair of Natural History in the University of Edinburgh during the ensuing summer session, in the absence of Prof. Wyville Thomson, who is with the *Challenger* Surveying Expedition.

THE Arctic Expedition Committee sits twice a week, and is making steady progress in organising preparations. The engines of the *Cygnet* gunboat, a new vessel, are to be removed and placed in the *Alert*, now in dock. Although not yet officially announced, we believe that the Admiralty have selected Commander Albert Markham as one of the commanding officers of the Arctic Expedition. Lieut. Aldrich, of the *Challenger*, is coming home with Capt. Nares to take part in the expedition. The decision recently made public that none but those of the Royal Navy would be permitted to take part in the expedition has been somewhat relaxed, and it is not improbable that some men of experience in whaling will be engaged as "ice quartermasters."

WE believe a few French naval officers desire to join the forthcoming English Polar Expedition, as Lieut. Bellot did on the occasion of one of the most interesting searches for Franklin. As is known, Bellot lost his life during the expedition, and the fact is commemorated by a column erected at Greenwich Hospital at the expense of the English Government.

LIEUT. CAMERON, in a despatch to Lord Derby, dated Ujiji, May 14, tells of an important discovery to which we briefly alluded last week in our report of the meeting of the Geographical Society. He has been all round the southern portion of Tanganyika, and believes he has discovered its outlet in a river named the Lukuga, a little to the south of Speke's Islands. He thinks also, from what he has heard from the Arabs, that the Lualaba is the Congo. The Lukuga he found to be obstructed with grass, but he believes a way might easily be cut through that. If Lieut. Cameron's conjectures turn out to be correct, and there appears to be great likelihood that they will, he will deserve to take an important place in the ranks of African explorers. He shows the great capabilities of Central Africa as a field for legitimate commerce, and if it turns out that navigation is possible from the mouth of the Congo to the Tanganyika region, much good may be expected to accrue to Africa as well as to the commercial world at large. The curse of the country is still those degraded Arab slave-dealers who vexed the soul of poor Livingstone, and it is a monstrous pity that some steps could not be taken to stamp out the demoralising and devastating traffic. Full details of Lieut. Cameron's explorations are in the hands of the Geographical Society.

THE last two parts of Petermann's *Mittheilungen* are naturally full of the Payer-Weyprecht expedition. The December number contains two letters from Lieut. Weyprecht, and one from Lieut. Payer, to Dr. Petermann. The former intimates that the amount of material collected in connection with the geography, meteorology, magnetism, &c., is immense; during the course of next year he will be preparing these for publication. He briefly states, as some of the conclusions he draws from the work of the expedition, that it is erroneous to conclude either that an open polar sea exists in the north, or that the ice on the south of Franz-Joseph's Land is impenetrable; that the drift of the ship in the ice was in no way owing to the Gulf Stream; and that he still adheres to the opinion that much valuable exploratory work can be done towards the east, with the Siberian coast as a basis of operations. Lieut. Payer believes that the nearest road to the pole is that by which the English Arctic Expedition is to go—Smith's Sound.

THE *Daily Telegraph* of Monday contains a long letter giving a very interesting account of Zanzibar, from Mr. H. M. Stanley, the leader of the expedition sent out by that paper in conjunction with the *New York Herald*. Another is to follow giving a description of the preparations for Stanley's long African march of discovery, and the detailed plans of route. This expedition is exceedingly creditable to the two papers, and it is a hopeful sign that a daily journal finds it answer to fill its columns with such healthy excitement.

A COMMUNICATION from her Majesty's ship *Scout* states that a monument has been erected on one of the islands of the Pacific to the memory of Captain Cook, who was killed by the natives of Owhyhee, ninety-five years ago. The monument is an obelisk 25 ft. high, and mounted on a base 8 ft. square. It is of concrete, and bears the following inscription:—"In memory of the great circumnavigator, Captain James Cook, R.N., who discovered these islands on the 18th of January, A.D. 1778, and fell near this spot on the 14th of February, A.D. 1779. This monument was erected in November, A.D. 1874, by some of his fellow-countrymen." It is erected on a suitable spot, about 100 yards from the rock on which the captain fell.

M. LEVERRIER, having finished with his tables of the Planet Neptune, will resume the duties of an active observer. For 1875 he will superintend personally the service of meridian observations at the Observatory of Paris, at the same time fulfilling all the duties of director of the establishment. M. Loewy will have the care of the special determinations of longitudes. These arrangements have been proposed by the Council of the Observatory to the Ministry, and will be no doubt approved of.

THE process of polishing the lens of the mirror of the great telescope is going on at the French National Observatory by M. Martin. The diameter of the lens is 120 centimetres, and the polisher is a disc of 40 centimetres. The number of men engaged on the polishing is six. They are obliged to stop frequently on account of the great weight of the polisher. An observer placed on the top of the Observatory, at a distance equal to half the focal distance, superintends the polishing process, watching if the image of a light which is placed in a proper position is reflected with sufficient exactness by the mirror below.

THE weather being very cold in Paris, and heavy falls of snow having taken place, M. Gaston Tissandier has taken advantage of the opportunity to make a series of most interesting observations on the dust which snow appropriates during its passage through the atmosphere. The results will be sent very shortly to the French Institute.

ON Thursday, December 17, at ten P.M., a magnificent falling star was observed in Paris. Its track was to be seen for more than a minute. A correspondent, Mr. J. H. A. Jenner, writing from Lewes, states that "on Thursday evening, the 17th inst., at 10.30, a very fine meteor was seen here. It travelled from north to south at a seemingly very low elevation, and though the moon was shining brightly, it was a very brilliant object, being several times the brightness of Sirius. Its colour was yellowish, and it left a long but not very persistent bluish-white train. Had the night been dark, it must have been a very splendid object. The point of disappearance was hidden from my sight by houses, but there was no noise attending it."

TWO students of Girton College have been examined in the Cambridge Natural Science Tripos. Miss Kingsland, daughter of the Rev. N. Kingsland, Congregationalist minister, Bradford, passed equal to second class, and has been appointed assistant lecturer in Natural Science and Mathematics at Girton College. The other, Miss Dove, daughter of the Rev. J. Dove, vicar of Cowbit, Lincolnshire, would have been entitled to the ordinary degree, and has been appointed to an assistant mistress-ship at Cheltenham Ladies' College, with a special view to teaching physiology. These ladies passed the *vivâ voce* examination, and also in physiology and chemistry.

DR. J. G. M'KENDRICK recently commenced in Edinburgh a series of lectures to ladies on Physiology, at which we are pleased to hear there is an attendance already of seventy-one ladies.

THE Laurium mines in Greece have given rise to a new difficulty, not of a diplomatic, but of a botanical nature. Seeds which had been buried amidst the remains of old explorations for 2,000 years, on being exposed to the air have undergone the usual process of germination, &c. These belong to the genus *glaucium*, but the species seems quite lost.

THE *Telegraphic Journal* for December 15 contains a figure and description of a most ingenious self-regulating electric lamp, by Siemens and Halske. This lamp is of very simple construction, and is stated to regulate itself with great accuracy. It is capable of being used either with a current of single direction or with the alternating current produced by certain magneto-electric machines.

WE have before us a Belgian Governmental publication in the *Bulletin de la Fédération des Sociétés d'Horticulture de Belgique*, for 1873. The volume contains biographies and portraits of eminent Belgian horticulturists recently deceased. A number of papers are printed in it, chiefly connected with Belgian horticulture; and it is supplemented by a list of all persons holding official botanical posts throughout the world.

LIEUT. CONDER, R.E., the officer in charge of the Palestine Survey Expedition, reports important discoveries of ruins in the hill country of Judah, which he proposes to identify with some of the lost Biblical cities and sites. He has been also engaged in a search for the limits of the Levitical towns, hoping to find some inscription or monument similar to that which rewarded M. Ganneau at the city of Gezer. He has not found any Hebrew inscriptions, but appears to have discovered boundary stones which may prove to be the ancient Levitical landmarks. Lieut. Conder promises to make a survey of Mr. Henry Maudsley's recent discoveries on Mount Zion for the Committee of the Palestine Exploration Fund.

THE report is to hand of Prof. Powell on the Survey of the Colorado of the West, dated Smithsonian Institution, Washington, D.C., April 30, 1874. This survey was placed under the direction of the Smithsonian Institution by Congress. The region embraced in the survey is one of the most interesting, in a geological point of view, in the world. The Colorado of the West and its tributaries traverse a series of remarkable chasms, in some instances of more than a mile in depth below the general surface of the region, presenting in several places, at one view, sections of the greater number of the known geological formations of America. In the report a general summary is given of the entire work. It exhibits a great amount of labour, and a series of results, not only of importance to science, but also to a knowledge of the country in its relations to agriculture and mineralogy. The report embraces a statement of what has been accomplished in the way of, first, Topography, as based on triangulation, including a description of the arable valleys, the supply of water, the extent of timber and of pasture land; second, Geology, including economic mineralogical products, such as coal, salt, and other minerals; third, Ethnology, comprising tribes, political organisation, languages, manners, customs, mythology, poetry, arts, &c.; fourth, Natural History, including mammals, birds, reptiles, insects, and plants.

SOME time since we intimated in NATURE that the enterprising Tyneside Naturalists' Field Club had resolved to catalogue all the remarkable trees in the extensive district which it works. The paragraph referred to has, we are glad to see, been the means of originating a similar enterprise in America. The New England Society of Orange, New Jersey, has issued the first of a series of publications, under the name of the "Babbit Portfolio," giving a history and description of the notable trees in its locality, accompanied by beautifully executed photo-engravings. The first number contains the "Valley Oak" (*Quercus albus*), the "Hillyer Elm" (*Ulmus americana*), and the "Harrison Buttonwood (*Platanus occidentalis*). Dr. Babbit, after whom the Portfolio is named, was the first to set out shade-trees in Orange.

PROF. BUCKLEY, State Geologist of Texas, has published a synopsis of the work done under his auspices during the past season, and remarks that fifty-four counties have been visited by himself and assistants. The results of his investigations show that Texas has vast deposits of iron and coal, of much greater extent than had been anticipated. Both are of excellent quality, and in some cases they occur near together. He has also found an abundance of salt, gypsum, and a wide range of copper ores. Other valuable minerals are roofing slate, marble, soapstone, &c.

THE Engineer Department of the United States Army has issued a "Catalogue of Plants collected in the years 1871, 1872, and 1873, with Descriptions of New Species." This is a portion of a series of publications brought out under the same auspices, being a report of geographical and geological explorations and surveys west of the 100th meridian, under the charge of First-lieutenant G. M. Wheeler.

WE are pleased to learn from the "Tenth Report of the Board for the Protection of the Aborigines in the Colony of Victoria," that the condition of the aborigines from the foundation of the colony was never so prosperous as at the present time. Very successful experiments at hop-growing have been made in some of the districts allotted to the natives, who take kindly to the light and comparatively well-paid work. The cultivation of hops will be extended to other districts. Considerable success has also been attained in the education of the children.

DR. JOHN DOWSON has sent us two pamphlets of which he is the author: "Thoughts, Philosophical and Medical, selected from the Works of Francis Bacon," and "A Sketch of the Life and Works of Erasmus Darwin, M.D., F.R.S." H. K. Lewis, Gower Street, is the publisher.

THE *Quarterly Journal* of the Meteorological Society, just issued, contains a number of papers read during the last session of the Society, abstracts of most of which have appeared in these pages.

THE "Proceedings of the Belfast Natural History and Philosophical Society" for 1872-3-4 have been published. Among the papers of scientific interest are the President's (Mr. J. J. Murphy's) addresses, "On Cosmological Science," and "On the present state of the Darwinian Controversy;" Prof. Everett "On Mirage," published in NATURE, vol. xi. p. 49; "On some New Methods of Chemical Analysis," by Prof. Hodges; "On the Solar Spots," by Mr. Murphy; "On Rainbow, Halos, and Coronæ," by Prof. Purser; "On Underground Temperature," by Prof. Everett; "On the Origin and Metamorphoses of Insects," by Mr. Murphy; "On the Composition of an Inflammable Gas issuing from below the Silt-bed in Belfast," by Dr. Andrews, F.R.S.

WE have received two reprints from the "Proceedings" of the Liverpool Geological Society, 1873-74: "The Metamorphic Rocks of the Malvern Range and the Strata derived from them," by Dr. C. Ricketts, F.G.S.; and "Tidal Action as a Geological Cause," by Mr. T. Mellard Reade, C.E., F.G.S.

IT is gratifying to see, from the Seventh Annual Report of the Eastbourne Natural History Society, that the Society is, on the whole, in a flourishing condition. It is doing very satisfactory work in the collection and arrangement of the fauna and flora of its district.

THE additions to the Zoological Society's Gardens during the past week include a Peregrine Falcon (*Falco peregrinus*), European, presented by Mr. A. F. Ross; a Campbell's Monkey (*Cercopithecus campbelli*) from West Africa, purchased; and eight Canadian Beavers (*Castor canadensis*) from North America, deposited.

THE ROYAL SOCIETY MEDALS

WE have already announced the names of those to whom the Royal Society Medals have been awarded; the following is the official account of the presentation by the Vice-President and Treasurer, Mr. Spottiswoode, at the Anniversary Meeting on the 30th ult.:—

The Copley Medal has been awarded to Prof. Louis Pasteur, one of our foreign members, "for his researches on Fermentation and on Pebrine."

Prof. Pasteur's researches on fermentation consist essentially of two parts: the first part, in which he enters exhaustively into the examination of the products formed in this process; and the second, in which he takes up the question of the cause of fermentation.

Previous observers had noticed the production, in solutions of sugar which had been fermented, of substances other than the two commonly recognised, alcohol and carbonic acid; but it remained for Pasteur to show which were essential and which were occasional products. In the series of able papers contributed to the *Comptes Rendus* and to the *Annales de Chimie et de Physique*, he proved conclusively that succinic acid and glycerine were always found in fermented solutions of sugar, while lactic acid and acetic acid, although occasionally present, were not always so. He also showed that, in addition to these substances, a part of the sugar was converted into cellulose and fat.

The study of the products formed during fermentation opened the way to the second part of the research, viz., the cause of fermentation.

It had been found that certain solutions, when exposed to the air, soon became full of living organisms; and Pasteur's experiments led him to support the view that these organisms originated from the presence of germs floating in the air. He found that no living organisms were developed if care were taken to destroy completely all those which might be present in the solution, and if the solutions were then carefully sealed up free from air. Nor was it necessary to exclude the air, provided that pure air, free from germs, were admitted. By passing the air through red-hot tubes or through gun-cotton before reaching the solutions, he found that the development of organisms, in such boiled solutions, did not take place. An exception to this was noticed in the case of milk, which required to be heated to a higher temperature than the boiling-point of water at atmospheric pressure. Pasteur showed that this was connected with the alkaline reaction of milk, for in all cases in which the development of life was prevented by heating to the boiling-point of water, the solutions had a faintly acid reaction—but that when this was neutralised by carbonate of lime, the solutions then behaved like milk.

Prof. Pasteur also examined the gun-cotton through which the air had been passed; and he found, among other things, certain cells to which he attributed the power of causing the growth of organisms in solutions. By sowing some of these cells in solutions which previously had remained clear, and finding that such solutions speedily became turbid from the growth of living organisms, it was proved that the air which had passed through the gun-cotton had lost its property of causing the development of life in solutions, because the germs which the air contained had been stopped by the gun-cotton.

The result of the second part of the research may be thus summed up:—

1. No organisms are developed in solutions if care be taken to prevent the possibility of the presence of germs.
2. This negative result does not depend upon the exclusion of oxygen.
3. The matter separated from ordinary air is competent to develop organisms in solutions which previously had remained unchanged.

Not less important were the results of Pasteur's experiments respecting the chemical functions of the ferment.

It had been held that the entire ferment was in a state of putrefactive decomposition, and induced a similar decomposition in the sugar with which it was in contact.

In corroboration of this view, it was stated that ammonia (a product of the decomposition of albuminous substances such as those present in the ferment) is always found in liquids which are undergoing fermentation.

Pasteur proved that the ammonia in fermenting liquids diminishes in quantity in proportion as the process advances, and that the yeast-cells increase and grow while forming complex albuminous substances at the expense of the ammonia and other aliments which are supplied to it. He found that, in addition to ammonia and sugar, the cells require mineral substances, such as phosphates and other constituents, such as are present in the organism of every healthy and growing yeast-cell.

In short, he proved that those conditions which are most favourable to the healthy growth and development of the yeast-cells are most conducive to the progress of fermentation, and that fermentation is impeded or arrested by those influences which check the growth or destroy the vitality of the cell.

The above results are but samples of the fruits of Pasteur's long series of researches in this subject. Many and many an able investigator had worked in the same field; and such were the difficulties they encountered, that Dumas himself recommended Pasteur not to waste his time in working at so hopeless a subject.

To the biologist, two of Pasteur's researches are of very great interest and importance. He has shown that *fungi* find all the materials needed for their nutrition and growth in water containing an ammonia salt and certain mineral constituents, and devoid of any nitrogenised organic matter; and he has proved that all the phenomena presented by the destructive silkworm epidemic, the *pebrine* (even the singular fact that it is hereditarily transmitted through the female, and not through the male), are to be explained by the presence of a parasitic organism in the diseased caterpillars.

The medal was received for Prof. Pasteur by the Foreign Secretary of the Society.

The Rumford Medal has been awarded to Mr. J. Norman Lockyer, F.R.S., "for his Spectroscopic Researches on the Sun and on the Chemical Elements."

Mr. Lockyer has long been engaged in spectroscopic researches on the sun. His first observations were directed to a scrutiny of the spectrum of sun-spots as compared with that of the general surface, with a view to bring evidence to decide between two rival theories respecting their formation. In the course of the paper in which his first observations were described, and which was read before the Royal Society on November 15th, 1866, he asks, "May not the spectroscope afford us evidence of the existence of the 'red flames' which total eclipses have revealed to us in the sun's atmosphere, although they escape all other modes of examination at other times?"

The spectroscope he then employed proved to be of insufficient dispersive power for his researches, and he was induced to apply to the Government-Grant Committee of the Royal Society for aid to construct one of greater power. This aid was accorded, and the instrument was delivered, though not quite complete, on the 16th of October, 1868. On the 20th his efforts were crowned by the detection of a solar prominence by means of the bright lines exhibited in his spectrum. An account of this discovery was immediately communicated to the Royal Society and to the French Academy of Sciences.

Meanwhile had occurred the total solar eclipse of August 18th, 1868, to observe which various parties had gone out armed with suitable instruments, and especially with spectroscopes, for determining the character of the hitherto unknown spectrum of the prominences; and the first-fruits of their labours had reached Europe, showing that the spectrum in question is one of bright lines. It occurred to M. Janssen, who had observed with eminent success the spectrum of the prominences during the eclipse, that the same mode of observation might enable one to detect them at any time, and he saw them in this manner the very next day. The first account of this discovery, which was sent by post, did not, however, reach the French Academy until a few days after the communication of Mr. Lockyer's notice; so that nothing interferes with the perfect independence with which these two physicists established the possibility of detecting the prominences at any time.

A discovery like this opened up a new field of research, which Mr. Lockyer was not backward in exploring. One of the first-fruits of the application of the method was the discovery of a continuous luminous gaseous envelope to the sun, which he calls the chromosphere, of which the prominences are merely local aggregations. Evidence was further obtained of gigantic convulsions at the surface of the sun, which were revealed by slight alterations of refrangibility in the lines, observed in a manner similar to that in which Mr. Huggins had determined the relative velocity of approach or recess of the Earth and Sirius.

The interpretation of spectroscopic solar phenomena required a re-examination in several respects of the spectroscopic features of artificial sources of light. Among these researches special mention must be made of Mr. Lockyer's classification of the lines due to the metals of the electrodes between which an induction discharge was passed, according to their "length," *i.e.*, the distance from the electrodes to which they could respectively be traced. This led to the explanation of various apparent anomalies as to the presence or absence of certain dark lines in the solar spectrum, and to the detection of additional elements in the sun, especially potassium, an element which, though so common on the earth and so easily detected by spectral analysis, had not previously been proved to exist in the sun, because the attention of observers had been turned in a wrong direction, as was shown by these researches.

Nor was it only in relation to solar physics that these researches bore fruit. They led to a *quantitative* determination in many cases, by means of the spectroscope, of the proportion of the constituents in an alloy, and afforded new evidence of the extent to which impurities are present even in substances deemed chemically pure.

The medal was received by Mr. Lockyer.

A Royal Medal has been awarded to Mr. Henry Clifton Sorby, F.R.S., "for his researches on slaty cleavage and on the minute structure of minerals and rocks; for the construction of the Micro-Spectroscope, and for his researches on colouring-matters."

The principal grounds on which Mr. Sorby's claims to a Royal Medal rest are the following:—

1. His long-continued study, and his successful application of the microscope to the solution of problems in petrology.

2. His employment of the prism in conjunction with the microscope for the analysis of the colours transmitted by substances, as well organic as inorganic.

Though Mr. Sorby's labours during the last ten years have been more particularly devoted to observations of the latter class, his work, extending over a period that commenced in 1849, is represented in the Catalogue of Scientific Papers (limited by the year 1863) by no less than forty-seven memoirs. Among the more remarkable of these must be mentioned the reports to the British Association and the contributions to the *Philosophical Magazine* (1853, 1856, 1857), in which he grappled with the subject of slaty cleavage, and helped to establish the explanation that cleavage was the result of greater relative condensation of the material in a direction perpendicular to the cleavage, due in the case of rocks to mechanical compression in that direction—an idea that met with immediate illustration from other experimentalists.

His memoirs on the temperatures and pressures at which certain rocks and minerals were formed (in the Geological Society's *Journal*, 1858), founded on the relative volume of the liquid and vacuous portions of microscopic hollows, or, again, on the character of microscopic substances mingled with the mineral matter he investigated, convinced the geologist that he had to take into account the action of water under high pressures and at high temperatures in explaining the formation of granitoid rocks. And the refinement of the methods that Mr. Sorby employed for making his rock-sections at Sheffield has made those methods the models sought after by the now large school of Continental and English microscopic petrologists.

His applications of spectroscopic methods to the microscope fall more strictly within the limit of ten years, as they have been worked out since 1867, when Mr. Sorby first described his adaptation of the spectroscope to the microscope, as carried out by Mr. Browning.

The observations he has made with this instrument, and generally by combining optical examination with the use of chemical reagents, have extended over a very wide range—such as the recognition of blood-stains, of adulteration in wine, the means of discriminating among the compounds of certain of the metals, chiefly of zirconium, titanium, and uranium, by the aid of blowpipe beads—and finally to the elucidation, to a considerable extent, of the causes of the complexity in the tints exhibited by plants in the different stages of development of their annual foliage and flowers.

These are only some of the more important of Mr. Sorby's contributions to science; and they are characterised by an untiring application of the methods of experimental research to a great variety of subjects suggested by a very ingenious and active mind.

The medal was received by Mr. Sorby.

A Royal Medal has been awarded to Prof. William Crawford Williamson, F.R.S., "for his contributions to Zoology and Palæontology, and especially for his investigation into the structure of the fossil plants of the coal-measures."

Prof. Williamson's contributions to biological science were commenced forty years ago, and embrace investigations into the structure of the Foraminifera, the Rotifera, the scales and bones of fishes, and the fossil plants of the Carboniferous and Oolitic periods. These comprise works of great merit and value, not only on account of their accuracy and the extent and novelty of the observations which they contain, but by reason of the breadth of view and the philosophical spirit which pervade them.

His labours in Vegetable Palæontology are above all remarkable, being alike laborious, searching, and productive of important results. These are embodied in six contributions (of which the last will soon appear) to the Philosophical Transactions upon the organisation of the fossil plants of the coal-measures—and one on the restoration of a Cycadeous tree (*Zamia gigas*) from the Yorkshire Oolite, published in the Transactions of the Linnean Society. These are not only models of laborious research and exact description, but they are illustrated by more than fifty plates, devoted to microscopic analyses of vegetable tissues, obtained by making transparent slices of the fossils. Both the slices and the drawings are made by Prof. Williamson himself, who thus, to his reputation as a biologist, unites those of an accomplished artist and a skilful lapidary, qualifications which should be named along with those for which the medal is awarded, because no unscientific lapidary could have obtained equally illustrative sections, and no common artist could have depicted them with equal exactitude. The more important results thus obtained refer to the structure, affinities, and reproductive organs of Calamites and its allies, to Lepidodendron, Sigillaria, Lepidostrobus, Asterophyllites, and to other genera of the Carboniferous epoch.

In addition to these contributions to the history of previously known genera of that epoch, Prof. Williamson has been able to show, on the one hand, that groups of now living plants which were not previously supposed to have a great geological antiquity, actually flourished during the Carboniferous period, and, on the other, that plants of that period which had been previously referred with confidence to groups now living, have in reality other and widely different affinities.

The medal was received by Prof. Williamson.

SCIENTIFIC SERIALS

Astronomische Nachrichten, No. 2014.—In this number appear some interesting observations made by Nicolaus V. Konkoly on the spectrum of meteorites. Some 130 of the August meteors were examined, and it was observed that the nucleus gave a continuous spectrum, the apparent colour of the naked eye predominating in the spectrum. The tail of the yellow meteors gave the sodium lines only, the green one gave magnesium lines, and the red ones strontium or lithium. The sodium lines were present in all. In some of the larger meteors the author suspects the spectrum of iron is present.—Position observations of Coggia's comet are given by Argelander and by Tebbutt, of the Windsor Observatory, N.S. Wales.—Dr. Kleim writes objecting to the explanation of variation of brightness of Jupiter's moons during transit, given by Herr S. Alexander.—Dr. Luther gives position observations of Peitho (118) and elements of Danae (61).—The elements of Borrelly's comet are given by Grutzmacher, and those of Sylvia by Tietjen.—F. Anderson sends an opposition ephemeris of the planet Undina for November and December.—Prof. Spoerer gives observations of sun-spots and protuberances; and observations of the occultation of Venus by the moon, taken at Kiel, are given.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie.—Dec. 1.—In an article on the non-periodic movements of the barometer and the baric windrose, Dr. Köppen, taking into consideration the almost constant cyclonic movement of the air in Europe, asks how it is, while gradients are steepest with west and south-west winds, that when the barometer is observed at equal distances round a minimum centre, it is not found to be highest where the south-west wind is blowing. The mean height of the barometer is on the contrary considerably higher with north and east winds. The explanation lies in the difference between northern and southern Europe with respect to the magnitude of non-periodic oscillations of the barometer. —The low pressure in the north and north-west during the prevalence of south-west winds is not compensated by an adequately high pressure in the south and south-east. Air flows thence either to form a maximum over a small space in high latitudes, or southwards over a large space without causing high pressures. Similarly, but conversely, with north and east winds. —Among the "Kleinere Mittheilungen" we have a notice of Prof. Dove's article on cool Mays after mild Januarys, published in the magazine of the Berlin Academy. Herr Dove regards as proved a tendency to low temperatures in spring after warm winters. It appears that a mild January is generally followed in the interior of continents by a mild May, on the north and east coasts by a cool May, on the Atlantic Ocean again by a May milder than usual.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Dec. 10.—"On the Development of the Teeth of the Newt, the Frog, and certain Lizards, and on the Structure and Development of the Teeth of Ophidia." By Charles J. Tomes, M.A.

The descriptions given by Arnold and Goodsir of the development of the human teeth have been already demonstrated to be in material respects inaccurate as applied to man and other Mammalia; and the present paper shows that the accounts propounded by Prof. Owen, of the process in Batrachia and Reptilia, which are practically an extension of the theories of Goodsir to these classes, are even more at variance with the facts of the case.

There is in no Batrachian or Reptile any open groove or fissure ("primitive dental groove"); there are, at no period of development, free papillæ; consequently the whole process of "encapsulation" has not any existence, but is purely hypothetical. From first to last the whole process of tooth development takes place in solid tissue, beneath an even and unbroken surface; with which, however, the young tooth sacs have a connection through a band of epithelial cells. The first process is a dipping down of a narrow process of the oral epithelium, the extremity of which, after it has penetrated in some, as the snake, to a great depth, becomes dilated, and is transformed into the enamel organ; and this is the case whether a recognisable coat of enamel is or is not to be found on the perfect tooth. Subsequently to the dipping in of the band of epithelium, and concomitantly with the dilatation of its end, a dentine pulp is formed opposite to it. This may constitute the entire tooth sac, which is then wholly cellular, as in the newt; or it may go on further to the formation of a connective-tissue tooth capsule. The external thin structureless coating of the teeth of Ophidia is derived from an unmistakeable enamel organ, developed as above described; it is therefore enamel, and not cementum, as it is denominated by Prof. Owen. The successional tooth sacs, very numerous in the snakes, are located in a sort of capsule: this character, peculiar to the Ophidia, and most marked in the lower jaw, is of obvious service during the extreme dilatation which the mouth undergoes, as is also the tortuosity of the process of epithelium, before it reaches the collection of tooth sacs. The epithelial band may be traced winding by the side of the older tooth sacs till it reaches the position of the youngest, where it ends in a cæcal extremity, to be transformed into the enamel organ next developed. In fine, the stages of open groove, free papillæ, and encapsulation of the same have no existence whatever in Batrachia and Reptilia, their existence having been previously disproved in Mammalia.

"Experiments showing the Paramagnetic condition of Arteria Blood, as compared with the Diamagnetic condition of Venous Blood." By Richard C. Shettle, M.D.

The experiments consist in suspending between the poles of a powerful electro-magnet arterial blood, hermetically sealed in a glass tube, in a medium of venous blood, and venous blood in the same tube, previously well emptied of its contents, in a medium of arterial blood, care being taken to avoid as far as possible any exposure of the blood to the atmosphere; thus preventing any alteration in its physical characteristics as regards the gases which it contains.

In the former of the two cases the testing tube was found to take an axial, and in the latter an equatorial position.

Dec. 17.—"Note on the Vertical Distribution of Temperature in the Ocean." By J. Y. Buchanan, chemist on board H.M.S. *Challenger*. Communicated by Prof. A. W. Williamson, For. Sec. R.S.

From newspapers and other reports which have been received by late mails, it appears that the distribution of temperature in the ocean is occupying the attention of a certain portion of the scientific public, and even giving rise to considerable discussion. The observations made on board this ship, and more especially in the Atlantic, have furnished the greater part of the material on which the various speculations have been founded. It appears to me that one point suggested by these observations has not received sufficient attention from those who have written and spoken on the subject—I mean the effect of the changing seasons on sea-water. Consider the state of the water at and near the surface of the ocean, somewhere not in the tropics. To be more precise, let us suppose that we have taken up our position in the middle of the North Atlantic, somewhere about the 30th parallel. This part of the ocean is not vexed with currents, and affords the best possible field for the observation of the phenomenon in question. The whole ocean, enclosed by the 20th and 40th parallels of north latitude, and the meridians of 30° and 60° west longitude, forms one oceanic lake, not affected by the perturbing influence of currents or of land; and where, therefore, the true effect of differences of atmospheric temperature on the waters of the ocean may be most advantageously studied. Let us assume the winter temperature of the surface-water to be 60° F. and the summer temperature to be 70° F. If we start from midwinter, we find that, as summer approaches, the surface water must get gradually warmer, and that the temperature of the layers below the surface must decrease at a very rapid rate, until the stratum of winter temperature, or 60° F., is reached; in the language of the isothermal charts, the isothermal line for degrees between 70° F. (if we suppose that we have arrived at midsummer) and 60° F. open out or increase their distance from each other as the depth increases. Let us now consider the conditions after the summer heat has begun to waver. During the whole period of heating, the water, from its increasing temperature, has been always becoming lighter, so that heat communication by convection with the water below has been entirely suspended during the whole period. The heating of the surface water has, however, had another effect, besides increasing its volume; it has, by evaporation, rendered it denser than it was before, at the same temperature. Keeping in view this double effect of the summer heat upon the surface water, let us consider the effect of the winter cold upon it. The superficial water having assumed the atmospheric temperature of, say, 60° F., will sink through the warmer water below it, until it reaches the stratum of water having the same temperature as itself. Arrived here, however, although it has the same temperature as the surrounding water, the two are no longer in equilibrium, for the water which has come from the surface has a greater density than that below at the same temperature. It will therefore not be arrested at the stratum of the same temperature, as would have been the case with fresh water, but it will continue to sink, carrying of course its higher temperature with it, and distributing it among the lower layers of colder water. At the end of the winter, therefore, and just before the summer heating recommences, we shall have at the surface a more or less thick stratum of water, having a nearly uniform temperature of 60° F., and below this the temperature decreasing at a considerable, but less rapid rate, than at the termination of the summer heating. If we distinguish between *surface water*, the temperature of which rises with the atmospheric temperature, following thus, in direction at least, the variation of the seasons, and *sub-surface* water, or the stratum immediately below it, we have for the latter the (at first sight) paradoxical effect of summer cooling and winter heating. The effect of this agency is to diffuse the same heat to a greater depth in the ocean, the greater the yearly range of atmospheric temperature at the surface. This effect is well shown in the chart of isothermals, on a vertical section between Madeira and a position in lat. 3° 8′ N., long. 14° 49′ W. The isothermal line for 45° F. rises from a depth of 740 fathoms at Madeira, to 240 fathoms at the above-mentioned position.[*] In equatorial regions there is hardly any variation in the surface-temperature of the sea; consequently, we find cold water very close to the surface all along the line. On referring to the temperature section between the position lat. 3° 8′ N., long. 14° 49′ W., and St. Paul's rocks, it will be seen that, with a surface-temperature of from 75° F. to 79° F., water at 55° F. is reached at distances of less than 100 fathoms from the surface. Midway between the Azores and Bermuda, with a surface-temperature of 70° F., it is only at a depth of 400 fathoms that we reach water of 55° F.

The above theory of vertical diffusion of temperature in the ocean, owing to convection brought about by the yearly range of temperature at the surface, presupposes that (at least in regions where the range is considerable, and where the great vertical diffusion of heat in question is oberved) the slightly concentrated water, descending from the surface as the winter approaches, does not meet water of greater density at the same temperature than its own. Unfortunately the determination of the specific gravity of water below the surface is much less simple than that of the temperature. For although we have an instrument which gives, within any required degree of accuracy, the density of the water at any depth in exactly the same way as the thermometer gives its temperature, the results of the observations are composed of three factors, which depend on the temperature, the pressure, and the *salinity*. By sending down a thermometer along with it we might clear the result for temperature; by noting the depth we might clear for pressure; but the result so cleared would not represent the salinity of the water at the depth in question, but the average excess of salinity of the column of water above it, over or under the mean salinity assumed for sea-water, in the calculation of the pressure exercised by a column of it. There remains, therefore, nothing for it but to fetch a sample of water from each depth, and determine its specific gravity on board. As this is an operation which takes up some time, the number of "serial specific gravity" determinations is comparatively small.

The following are the results of two which were obtained on the voyage between Bermuda and the Azores. The results show the specific gravity at 60° F., that of water at 39°·2 F. being taken as unity.

I. was taken on June 18, 1873, in lat. 35° 7′ N., long 52° 32′ W.

II. was taken on June 24, 1873, in lat. 38° 3′ N., long. 39° 19′ W.

For comparison I give one equatorial and one South Atlantic "serial specific gravity" determination.

III. was taken on Aug. 21, 1873, in lat. 3° 8′ N., long. 14° 49′ W.

IV. was taken on Oct. 3, 1873, in lat. 26° 15′ S., long. 32° 56′ W.

Depth in fathoms.	Specific gravity at 60° F. Distilled water at 39·2° = 1.			
	I.	II.	III.	IV.
0	1·02712	1·02684	1·02591	1·02703
50	...	...	1·02658	1·02682
100	...	...	1·02643	1·02649
150	1·02701	1·02677	...	...
200	...	...	1·02620	1·02608
250	1·02683	1·02641	...	...
300	...	...	1·02610	1·02573
400	...	...	1·02629	1·02554
500	1·02604	1·02608	...	...

From the figures in the Table it will be seen that in that part of the ocean the specific gravity of the water in summer decreases from the surface downwards. As a rule it attains an inferior limit at a depth of from 400 to 500 fathoms, which it preserves to the bottom. In those latitudes, therefore, the stratum of intermixture extends down to 500 fathoms; and this may be said also to be the depth to which the sun's influence at the surface penetrates. The results in column III. show the curious phenomenon of the surface water being specifically lighter than any water below it, and that under an equatorial sun. The position of this sounding was peculiar, inasmuch as it was within line of separation between the Guinea and the equatorial currents. All along the equatorial section the water at 50 and 100 fathoms was found to be specifically heavier than either at the surface or that at greater depths. All along the equator, however, a current runs with great velocity; and I have invariably observed that strong surface-currents introduce considerable irregularities into the specific gravity of the water near the surface. The effect of the greater specific gravity at 100 fathoms conspires, of course, within the small yearly range of temperature, in preventing vertical diffusion in the above described manner. Column IV. shows a return, in the southern hemisphere, to a state of things similar to that which obtains in the North Atlantic.

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[*] There will, I think, be no violence in assuming an acquaintance with these charts, at least among the scientific public, as they have lately formed the subject of lectures by Dr. Carpenter, and will no doubt have been published before this reaches England.

We have seen that the effect of climate in equatorial regions is to render the sub-surface water much colder than it is in temperate regions; let us consider what would be the effect of a polar climate on the sea-water. It must be observed that the effect of the atmospheric temperature on the sea is determined by the temperature assumed by the surface-water; now the lowest temperature which surface-water can attain is its freezing-point. As the temperature of the air when the *Challenger* was beyond the 60th parallel was almost constantly below 32° F., freezing must go on to a very great extent in winter, and the effect of freezing such water is, in the end, similar to that of evaporating it; it is separated into lighter ice, and denser mother-liquor, which sinks, leaving ice on the surface. This ice I found to be a mixture; and on determining the melting-point of some in crystals, which had formed in a bucketful of sea-water, I found it began to melt at 29·5° F., the water produced by it being almost fresh, in comparison with sea-water. The lowest temperature of surface-water registered was 27° F.; this happened on two occasions, but was quite exceptional, the usual surface-temperature varying from 32° to 34° F. At this temperature a sensible quantity of ice would melt, giving very light surface water. On two occasions the specific gravity of the surface water was found between 1·02400 and 1·02410. The specific gravity increased rapidly up to a depth of 100 fathoms, when it remained pretty uniform to the bottom. Here, as at the equator, it is in winter that the sub-surface water perceives the effect of the change of season, the mother-liquor of the forming ice diffusing in its descent the temperature of its formation.

In the discussion of oceanic phenomena too much attention is usually paid to the great currents. When it is wished to study the phenomena due to temperature, or to any single cause, the effect of the winds, which is seen in its most intense form in the ocean currents, should be eliminated as far as possible; which in this case can only be done by selecting comparatively motionless seas, like the one which I have mentioned in the North Atlantic.* When the effect of atmospheric climate has been studied on the ocean at large, it would then be proper to apply the experience gained to the consideration of the more complicated phenomena of the currents.

I am at present engaged in a detailed consideration of the temperature and specific gravity results, principally in the direction above indicated, and hope shortly to be able to send it home for publication.

"On Polishing the Specula of Reflecting Telescopes," by W. Lassell, F.R.S., V.P.R.A.S.

The object of this paper is to describe a method of giving a high lustre and true parabolic curve with ease and certainty, by appropriate machinery, to the surfaces of the specula of large reflecting telescopes.

Linnean Society, Dec. 17.—Dr. Allman, president, in the chair.—Dr. Allman read a paper on "The diagnosis of new genera and species of hydroids," which we will give next week.—Mr. Daniel Hanbury exhibited specimens of an African *Kleinia* which had flowered at Mentone.—Mr. Pryor exhibited branches of the famous "Glastonbury Thorn," noted for always flowering in December.—Sir J. Lubbock, Bart., F.R.S., read "Observations on Bees, Wasps, and Ants." In this paper the author continued the observations read before the Linnean Society last year. In order to test the power of communication which they possessed, he placed various bees on honey, but found that if the honey was out of sight and in a place not frequented by bees, few, if any, others came. For instance, he brought a bee to a honeycomb, weighing 12½ lbs., placed on his writing table; she returned over and over again, but no other bee came. Other experiments of the same kind convinced him that some bees at any rate do not communicate with their sisters, even if they find an untenanted comb full of honey, which to them would be a perfect Eldorado. This is the more remarkable because these bees began to work in the morning before the rest, and continued to do so even in weather which drove all the rest into the shelter of the hive. That a few strange bees should have found the honey is natural enough, because there were a good many bees about in the room. With reference to the affection which bees are said to feel for one another, he observes, that though he had repeatedly seen them lick a bee which had smeared herself in honey, he never observed them show the slightest attention to any of their comrades who had been drowned in water. Far, indeed, from having been able to discover any evidence of affection among them, they appear to be thoroughly callous and utterly indifferent to one another. As already mentioned, it was necessary for him occasionally to kill a bee, but he never found that the others took the slightest notice. Thus, on the 11th of October he crushed a bee close to one which was feeding, in fact so close that their wings touched; yet the survivor took no notice whatever of the death of her sister, but went on feeding with every appearance of composure and enjoyment, just as if nothing had happened. When the pressure was removed, she remained by the side of the corpse without the slightest appearance of apprehension, sorrow, or recognition. It was, of course, impossible for her to understand his reason for killing her companion, yet neither did she feel the slightest emotion at her sister's death, nor did she show any alarm that the same fate should befal her also. In a second case exactly the same occurred. Again, if while a bee is feeding, a second bee is held by the leg close to her, the prisoner, of course, struggles to escape and buzzes as loudly as she can, yet the selfish (?) eater takes no notice whatever. So far, therefore, from being at all affectionate, he doubts whether bees are in the least fond of one another. Their devotion to their queen is generally quoted as a most characteristic trait; yet it is of the most limited character. For instance, on one occasion he changed his black queen for a Ligurian, and placed the old queen with some workers in a box containing some comb. Sir John was obliged to leave home on the following day, but when he returned on the 20th he found that all the bees had deserted the poor queen, who seemed weak, helpless, and miserable. On the 31st the bees were coming to some honey at one of his windows, and he placed this poor queen close to them. In alighting, several of them even touched her, yet not one of them took the slightest notice of her. The same queen, when afterwards placed in the hive, immediately attracted a number of bees. Although the experiments on colour which Sir John has already recorded are tolerably conclusive, still he thought it would be worth while to make some more. For instance, he brought a bee to some honey which he placed on blue paper, and about three feet off he placed a similar quantity of honey on orange paper. After the bee had returned twice he transposed the papers, but she returned to the honey on the blue paper. After she had made three more visits, always to the blue paper, he transposed them again, and she again followed the colour, though the honey was left in the same place. The following day he was not able to watch her, but on the 14th she returned to the honey on the blue paper. He then again transposed the papers. At 8·5 she returned to the old place and was just going to alight, but observing the change of colour, without a moment's hesitation dashed off to the blue. No one, he says, who saw her at that moment could have entertained the slightest doubt about her perceiving the difference between the two colours. He then proceeded to recount some experiments on the sense of smell possessed by bees, on their power of recognising their own companions, and on the different occupations of different bees, mentioning observations which seem to show that the bees act as nurses during the first few weeks of their life, and only subsequently take to collecting honey and pollen. He then proceeded to mention some experiments on wasps, which show that they possess the power of distinguishing colour. In conclusion he recorded a number of experiments on ants, which certainly seemed to show that, whatever may be the case with bees, ants do possess the power of communicating detailed facts to one another. It is remarkable, however, how much individual ants appear to differ from one another in character.

Chemical Society, Dec. 17.—Prof. Gladstone, F.R.S., vice-president, in the chair.—A paper On Groves' method of preparing chlorides, by Dr. Schorlemmer, F.R.S., was read. He finds that the process does not answer well for the higher primary alcohols, although secondary chlorides can readily be prepared by it. The other papers were: On the precipitation of metals by zinc, by Mr. G. L. Davies; Researches on the paraffins existing in Pennsylvanian petroleum, by M. T. M.

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* It will be seen that the principle, that the depth to which the effect of the sun's rays penetrates depends on the yearly range of temperature of the water at the surface, explains the presence of the large body of comparatively warm water in the North Atlantic, the existence of which has been usually ascribed to an assumed reflux or back water of the Gulf Stream. The warm water is due to no extraneous cause, but is the natural effect of the conditions of climate at the surface; and the effect of these conditions of climate are so apparent in the temperature of the water, just because it is free from the influence of oceanic currents, and exposed to the effects of climate alone.

Morgan; Some remarks on the preceding paper by Dr. Schlorlemmer; and a Note on Aricine by Mr. D. Howard, who finds that this is really a distinct alkaloid existing in certain kinds of reputed cinchona barks.—The Chairman announced that Prof. C. Maxwell had promised to give a lecture on the 18th of February, On the dynamical evidence of the molecular constitution of bodies.

Meteorological Society, Dec. 16.—Dr. R. J. Muir, president, in the chair.—The following papers were read:—Atmospheric pressure and rainfall, by John C. Bloxam, F.M.S.—Remarks on West India Cyclones, by H. F. Jahncke. This paper is a continuation of a former one read before the Society in February last.—Notes on the weather experienced over the British Isles and the north-west of France during the first few days of October 1874, by R. H. Scott, F.R.S. The object of this paper was to show that the charts in the *Bulletin International* are drawn upon insufficient data. It also recommended the adoption of the conical projection on charts for meteorological purposes.—On a new self-registering hygrometer, by H. Negretti, F.M.S., and J. W. Zambra, F.M.S.—Results of meteorological observations made at and near St. Paul's Island, in the South Indian Ocean, by R. H. Scott, F.R.S.—Description of a new patent portable magnetic anemometer and current meter for maritime use, by R. M. Lowne.

Entomological Society, Dec. 7.—Sir Sidney Smith Saunders, C.M.G., president, in the chair.—Mr. E. A. Fitch exhibited some oak-galls formed by insects of the genera Dryocosmus and Aphilothrix, of which descriptions had been published in a recent number of the *Entomologist's Monthly Magazine*, together with three curious bud-galls, unknown, from Rayleigh, in Essex.—Mr. Champion exhibited a box of Hemiptera, collected by Mr. J. J. Walker in different places near the Mediterranean.—Prof. Westwood forwarded a letter he had received from Mr. Stone, accompanying a sample of tea imported from Shanghae, infested by a small beetle which proved to be the *Ptinus hololeucus*. Also a letter from Prof. Forel, of Lausanne, stating that the *Phylloxera vastatrix* had made its appearance among some vines at Pregny, in the canton of Geneva, which had been introduced from England into the graperies of the Baron Rothschild, and that the Phylloxera had been discovered in two of his greenhouses among vines planted in 1869, sufficiently distant from each other to render it improbable that the insect had been communicated one from the other; and he therefore concluded that the disease had been introduced in 1869 from the graperies in England. He was anxious to ascertain whether the vines in the English graperies were less influenced than those out of doors; but none of the members present were aware of the occurrence of the insect in England out of doors, as it had hitherto appeared in greenhouses only.—Mr. C. O. Waterhouse communicated some "Synonymical Notes on Longicorn Coleoptera."

PARIS

Academy of Sciences, Dec. 14.—M. Frémy in the chair.—The proceedings commenced by M. De Lacaze-Duthiers presenting to the Academy the first two volumes of his "Archives of Experimental Zoology."—The following papers were then read:—On the originating centres of the plague of 1858 and 1874; epidemic nature and contagion of this plague; by M. J. D. Tholozan.—Note on the distribution of water in Egypt and in Greece, by M. Belgrand.—M. Le Verrier presented a new theory of the planet Neptune.—Determination of the velocity of light and of the sun's parallax, by M. A. Cornu. As the mean of 504 experiments, the author has obtained the value 300,000 kilometres per second for the velocity of light *in vacuo*. The determination of the solar parallax is determined in three ways: (1) Observation of the eclipses of Jupiter's satellites—mean result 8″85. (2) Analytical methods founded on the comparison of astronomical observations with theoretical laws based on the principle of gravitation—mean result 8″86. (3) Geometrical methods founded on the parallactic displacement of certain planets. Result obtained from opposition of Mars in 1862 was 8″84.—Observations on the phenomena essential to fertilisation in the fresh-water Algæ of the genus *Batrachospermum*, by M. Sirodot.—Theory of cyclonic meteorological phenomena, by M. Couste.—Observations on the reproduction of the Phylloxera of the vine, by M. Balbiani.—The American species of the genus Phylloxera, by Mr. C. V. Riley. The author recognises sixteen well-defined species.—Method followed in searching for the most efficacious substance to oppose to Phylloxera at the viticultural station of Cognac, by M. Max Cornu.—Experiments made with poisonous agents on healthy vines, by M. Baudrimont.—Telegrams from M. Janssen, director of the Japanese Transit of Venus Expedition, to the Minister of Public Instruction, to the Academy of Sciences, and to the "Bureau des Longitudes," were read. Letters referring to the transit were received also from M. E. Mouchez, director of the station at St. Paul, and from M. Fleuriais, director of the Pekin station.—Observations on Borrelly's last comet, by M. Stéphan.—On the stability of equilibrium of a heavy body resting on a curved support, by M. C. Jordan.—On cubic residues, a note on the theory of numbers, by M. P. Pepin.—On two simple laws of the active resistance of solids, by M. J. Boussinesq. This is a continuation of the former paper bearing this title.—Observations relating to a recent communication by M. Volpicelli on electric induction, by M. E. Blavier.—On the inconvenience of employing vessels of Bohemian glass in chemical analysis, and particularly in alkalimetry, by M. P. Truchot. The author states that French soda glass is not sensibly attacked by boiling water.—On the action of hydrogen on silver nitrate, by M. N. Békétoff. It had been stated by M. Roussel that silver nitrate was reduced by hydrogen, while, on the other hand, M. Pellet maintained that pure hydrogen had no action on solutions of this salt, and that reduction was effected in such cases by the presence of traces of arsenic in the hydrogen employed, or by the presence of an excess of silver oxide in the nitrate. The author of the present communication made, therefore, a series of experiments with carefully purified hydrogen, from which he concludes that this gas does reduce the nitrate either in neutral or feebly acid solutions. The recent researches by Dr. Russell in this country on the same subject do not seem to have come under the author's notice.—Action on the economy of the derivatives of the biliary acids, on the colouring matters of the bile, and on cholesterine, by MM. V. Feltz and E. Ritter.—Anæsthesia produced by the intra-venous injection of chloral in a case of hollowing of the tibia and ovariotomy; acidity of the chloral solution; method of neutralising it, by M. Oré.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—Gums, Resins, Oleo-Resins, and Resinous Products in the India Museum or produced in India: Dr. M. C. Cooke (London, India Museum).—Economic Geology; or, Geology in its relation to Arts and Manufactures: David Page, LL.D., F.C.S., &c. (Wm. Blackwood).—The Last Journals of David Livingstone. 2 vols.: Horace Waller, F.R.G.S. (John Murray).—Origin of Creation; or, the Science of Matter and Force: Thos. R. Fraser and Andrew Dewar (Longmans).—The Botanical Locality Record Club: Report of the Recorder for 1873 (E. Newman).—Anthropological Notes and Queries: British Association (Stanford).—The Conflict between Religion and Science: J. W. Draper, M.D. (H. S. King and Co.)—The Doctrine of Descent and Darwinism. International Series: Oscar Schmitz H. S. King and Co.)

AMERICAN.—The "Babbit Portfolio." New England Society of N.J., (United States).—Memoir of the Founding and Progress of the United States Observatory: Prof. J. E. Nourse, U.S.N. (Washington).

FOREIGN.—Bulletin de la Fédération des Sociétés d'Horticulture de Belgique (Liége).

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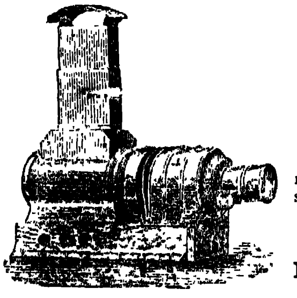

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THURSDAY, DECEMBER 31, 1874

GALTON'S "ENGLISH MEN OF SCIENCE"

English Men of Science; their Nature and Nurture. By Francis Galton, F.R.S., author of "Hereditary Genius," &c. (London: Macmillan and Co., 1874.)

IT would be difficult to overrate the exact and scientific spirit in which Mr. Galton proceeds with his investigation into the origin of genius and the antecedents of successful promoters of science.

The work of M. de Candolle upon the history of two hundred scientific men who have lived during the two last centuries appears to have suggested the character of the present work in some degree. But Mr. Galton has attacked the problem in a novel manner, by going directly to men living in the present day, and presenting a series of questions as to their parents, characters, and education. He began by carefully selecting a list of scientific men, which, though not intended in any way to be exhaustive, should at least not include any but those who have shown true ability. For this purpose he adopted election to the Royal Society, since the method of election was reformed, as the first test; and out of the considerable number of such Fellows he next selected those who had earned a medal for scientific work, had presided over a learned society or section of the British Association, had been on the Council of the Royal Society, or, finally, had acted as professors in some important college or university.

The list thus framed was found to contain 180 names. Incidentally Mr. Galton inquires what fraction this number forms of the total number of scientific men living in the United Kingdom and possessing the same general scientific status. By various tests he arrives at the conclusion that the total number would be three hundred, and he estimates that their proportion to the male population of the same ages would be about that of one in ten thousand. Of course Mr. Galton must be aware that his definition of scientific men is purely arbitrary, and that the circumscribing line might have been drawn more or less strictly, and made to include almost any number.

For the purposes in view, however, Mr. Galton's procedure must be considered perfectly satisfactory. To every one of the 180 men he forwarded elaborate printed forms, covering seven large quarto pages, and containing an immense number of minute inquiries. Each man was requested to state his parentage and descent, the religious opinions, occupations, birthplace, political party, health, stature, complexion, temperament, size of head, and a great many other particular facts concerning both his parents and himself. Inquiries were also made regarding his brothers and sisters, and their salient characteristics. The numbers and principal achievements of more distant relatives, grandparents, uncles and aunts, cousins, nephews, and nieces were also to be stated. Finally, the mode and duration of education of the scientific man himself was to be described, and the causes of success of which he was conscious were to be analysed.

In order to estimate the degree of intensity of characteristics, Mr. Galton devised a very ingenious and highly scientific method of class notation, founded on the law of error or divergence from a mean. This method was employed in his work on "Hereditary Genius," and was also described in his lecture before the Royal Institution in 1874. Instead of saying that a person's memory was remarkable, or prodigious, or moderate, or poor, the answerer was to attempt to define with some numerical precision the proportion which persons of each degree of memory bore to the whole population, by assigning him to one or other of certain defined classes. If such definite answers could have been obtained, the theory of probability could have been directly applied and the amount of the influence of heredity mathematically investigated. Such a method would constitute a distinct advance in statistical inquiry. Unfortunately, few definite answers of the kind seem to have been received, and this branch of the inquiry had for the present to be abandoned.

When we consider the elaborate and careful manner in which Mr. Galton conducted his investigation, it is difficult not to feel some slight disappointment at the results as stated in this volume. The book is certainly one of very great interest and not devoid of amusing points; but it seems to me to fail in establishing many truths in a definite manner. Not a few of the results derived were known beforehand almost as accurately as they are proved by the contents of this volume. We learn, for instance, that scientific ability is undoubtedly hereditary in some degree. Now, I should hold that such a proposition needs no new proof. It was sufficiently established in Mr. Galton's former work, and he seems as if he were always combating the objections of some imaginary opponents. I am not aware that anyone in the present day ever denies the hereditary character of personal peculiarities. Hardly is the infant ushered into the world than the nurse and the admiring relatives begin to discover the features of the father, or mother, or uncles, or aunts. Mr. Galton writes as if he were making a discovery whenever he attributes the character of a man to his descent. He says: "I have numerous returns, in which the writer analyses his own nature and confidently ascribes different parts of it to different ancestors. One correspondent has ingeniously written out his natural characteristics in red, blue, and black inks, according to their origin—a method by which its anatomy is displayed at a glance." I should have thought, however, that there was nothing novel in such analysis. Every family of intelligence must frequently have discussed the descent of characteristics, features, or diseases. We cannot hear that a youth has turned out badly without inquiring into the way in which the bad strain came into the family. What we really want are accurate estimates of the comparative power of heredity and education in shaping the character, and such results we hardly obtain.

Mr. Galton gives, indeed, the number of notable relatives of each grade which scientific men on the average possess. Thus, 100 scientific men have 28 notable fathers, 36 brothers, 20 grandfathers, and 40 uncles. It is curious that this series of numbers closely corresponds to what Mr. Galton obtained with regard to divines in his former work; but the falling off in the ability as we proceed from a distinguished scientific man to his distant relatives is less rapid, compared with his previous results, as the distance of the kinship increases. The influence of the paternal and maternal lines is found to be approximately equal. Thus, 100 scientific men have 34 distinguished relatives on the paternal side, and 37 on the maternal side.

The greater part of Mr. Galton's present work consists of a discussion concerning the mental characteristics and education of scientific men and their parents, and it is full of interesting particulars. We have many returns showing that the energy, both bodily and mental, of these men, is above the average in their own opinion. Not a few correspondents describe with evident pleasure their feats of strength :—

"Travelling almost continually from 1846 up to the present time. Restless. All life accustomed to extremely rough travel : often months without house or tent." "Strong when young—walked many a time fifty miles a day without fatigue, and kept up five miles an hour for three or four hours." "At the age of twenty-six, during fourteen days, was only three hours per night in bed, and on two of the nights was up all night." "I seem to possess the same unweariedness as my father, and find myself trotting in the streets as my father used to do." "At the age of sixty made a tour, chiefly pedestrian, of four weeks in the Alps. . . . Æt. 67, grouse shooting and deer stalking."

Such are a few of the very abundant statements showing that great power of work is a general characteristic of successful scientific men. Forty-two instances are adduced of energy above the medium, and only two men complain of the want of energy. It may perhaps be objected that such results hardly tell us more than we might have expected to hold true of any group of remarkable men. As a general rule men do not become eminent in the eyes of their contemporaries until they have lived a good long life, and done a considerable amount of work. I do not find that Mr. Galton gives us the average age of his correspondents, but half of them are stated to be between fifty and sixty-five years old, and many who speak of their great energy are very old men. If we inquired into the energy and power of work of all the Lord Chancellors or Attorney-Generals, we should doubtless find it very high, simply because a man cannot be a successful lawyer unless he can stand much work. We get from such inquiries, so far as I can see, no estimate of the comparative influence of quality and quantity of work. *Cæteris paribus,* the great worker has the odds in his favour if he can live and work long enough. Where, however, is the account of those who fall out and perish on the way? Where, too, is the account of the energetic men who, finding their first efforts in science less esteemed than they expected, devote their energies to some other career? When Mr. Galton proceeds, as I am glad to infer that he is doing, to investigate the antecedents of other classes of distinguished men, he will doubtless find that successful physicians are also men of great energy ; but where is the estimate of that subtle tendency which leads the energy into scientific study rather than practical life?

Perhaps the most interesting and immediately important part of the book is that in which Mr. Galton discusses the education of his selected men, and their own remarks as to its excellence or defects. We find that thirty-two men complain of a narrow education. Several of them make very strong remarks on the loss of time in classical studies :—"Enormous time devoted to Latin and Greek, with which languages I am not conversant." "Omission of almost everything useful and good, except being taught to read. Latin! Latin! Latin!" "Latin through Latin—nonsense verses." "In an otherwise well-balanced education, three years . . . were spent on Latin and Greek—a blank waste of time." Many complain of the want of mathematical training, and others deplore the omission of natural science. Two or three, on the other hand, think that a too exclusively mathematical training at Cambridge was injurious to them. There is, in fact, a very strong concurrence of opinion in favour of a varied education. Out of eighty-seven answers, ten distinctly praise the width, and thirty-two deplore the narrowness of their training, while others of the answers more or less imply a similar view.

This result seems to me of great importance as regards the vexed question of the London University Matriculation Examination. It is commonly objected that the University expects candidates to get up an impossible, or at least injurious, number of subjects—dead and living languages, history, mathematics, physical science, applied mathematics. The whole circle of the sciences and arts has to be studied in one style or another by the luckless candidate of sixteen years of age, before the University will admit him to have a place in its books. But if our object is to produce conspicuously useful men, Mr. Galton's book supplies strong evidence that this wide range of study is approved by those who look back upon their early education. We must remember, too, that even those who condemn the devotion of time to Latin or Greek form no fair specimen of people in general. Conspicuous ability in one direction is not unfrequently conjoined with inaptitude for other studies. If Mr. Galton interrogates eminent scholars, he is hardly likely to find the same severe condemnation of grammar. Moreover, much depends upon the way in which languages are taught. The mere grammar-school method of drilling grammar into the mind by rote may repel those who would be deeply interested by a more scientific method of teaching.

Language is rapidly becoming one of the most extensive and instructive fields for strictly scientific investigation. We can never too strongly and frequently protest against the evident tendency to interpret *science* as meaning *physical science,* whereas in the immediate future, if not in the present day, there are wider and more important fields for the application of scientific method in human than in external nature.

Some of those who are so strongly advocating the efficacy of physical science would do well to take note of the fact that few of Mr. Galton's picked men advocate study of physical sciences at all in a conspicuous way. Judicious mathematical training and a rational mode of teaching modern languages are advocated almost equally with the sciences of observation.

"Omission of mathematics, German, and drawing." "Want of education of faculties of observation ; want of mathematics and of modern languages." "Neglect of many subjects for the attainment of one or two." "Want of the modern languages and of chemistry." "Want of logical and mathematical training." In these and many other replies too long to quote, the correspondents carefully couple two or more branches of study together in their recommendations. Very few complain that their education was too general and desultory, and one of these adds that it nevertheless "gave wide interest." It is worthy of notice that a large proportion of those who praise their education were brought up in Scotland.

The conclusions which Mr. Galton adopts as to the best course of education according to the opinion of his correspondents are as follows:—"To teach a few congenial and useful things very thoroughly, to encourage curiosity concerning as wide a range of subjects as possible, and not to over-teach." This nearly coincides with the saying attributed to De Morgan, that a good education consists in teaching "everything of something, and something of everything." But when Mr. Galton describes the best curriculum as compounded of mathematics, logic, observation, theory and experiment in at least one branch of science, accurate drawing, and mechanical manipulation, he seems to underrate the degree in which the study of modern languages was advocated. Mr. Galton would leave these languages to be picked up in the vacation "in the easiest and swiftest manner, with the sole object of enabling the learners to read ordinary books in them." There are, I think, very few boys who would learn any but their native tongue in this way. Most people will hold that languages should be substituted for mechanical manipulation in the school course, and that a boy may safely be left to teach himself carpentering, or other mechanical pursuits, if he only be supplied with a good set of tools.

It is of course impossible adequately to notice, in the limits of an article, the contents of a book which is far more interesting in its details than in its general conclusions. I should have liked to discuss Mr. Galton's investigation of the "origin of taste for science" in his correspondents. We find that a considerable preponderance of men believe that they had an innate taste or tendency towards science. No less than fifty-nine of them make distinct statements to this effect. In other cases, fortunate accidents, opportunities, professional influences, encouragement at home, the influence of teachers or friends, are mentioned as the determining or contributing causes. The reader who carefully studies the interesting answers elicited by Mr. Galton will probably agree with him that they are reliable as far as they go, but it is impossible to suppose that they allow of a real analysis of the causes of scientific taste and zeal. As Mr. Galton remarks, the *fortunate* accidents referred to by some correspondents will generally indicate the previous existence of a tendency, for similar accidents are continually happening to thousands of other persons without any similar effects. Are there not multitudes, again, encouraged by their parents, friends, or teachers, incited by the prospect of pecuniary advantage, or otherwise influenced towards science, who nevertheless do not yield, or, if yielding, never attain great success? A further great difficulty consists in distinguishing between the origin of great general ability and the circumstances which throw that ability into a particular groove of study. One correspondent says that his taste for botany is not innate. "I trace the origin of my botanical tastes to leisure; to the accidental receipt of De Candolle's 'Flore française' whilst resident in that country; and to encouragement from my mother." These accidental circumstances may have bent the twig, but was there not a vigorous hereditary power of growth which enabled that twig to develop itself?

In some cases it may well be doubted whether a correspondent has not mistaken the effect of imitation and friendly encouragement for innate tendency. One geologist writes as follows:—"Decidedly innate as regards coins and fossils. My father and an aunt collected coins and geological specimens, and I have both coins and specimens which have been in my possession since I was nine years old." He apparently thinks that the love of fossils and coins was an hereditary instinct, which would be a truly remarkable instance of heredity. But is it not much more likely that the instinct was that collecting instinct so strongly manifested among the youth of the present day as regards postage-stamps, and which seems to be a kind of abnormal development of the love of property which has been growing in the human race for several thousands of years? The passion for collecting often leads to the study of the objects collected, as is testified by several correspondents; and in this particular case there must have been a further influence in the examples of the father and aunt.

An objection which may be in some degree urged against Mr. Galton's results is the insufficient number of instances which can be adduced in any one branch of science. Granting that one hundred cases is enough for the drawing of an average, we must yet remember that the hundred include men of such different pursuits as abstract mathematicians, naturalists, botanists, practical chemists, statisticians. The kind of intellectual power which makes a man eminent in one branch may be very different from what is most conducive to eminence in another branch. Mathematical power is probably much more a gift of nature than interest in statistics. In treating the origin of taste for science Mr. Galton does classify his correspondents according to the branches of science recognised in the sections of the British Association, but in regard to education he makes no such division. Now, if the division be made, the instances in most of the branches become too few to give a satisfactory average; whereas if the division be not made, it may be objected that we are averaging results which are not drawn from a uniform basis. The correspondents who supplied answers capable of being utilised did not much exceed one hundred, which is really too small a number when spread over nine different regions of science. The body of scientific men can hardly be considered so homogeneous as would be an equal number of artists, or musicians, or engineers, or bankers of eminence.

The interest and value of Mr. Galton's results would have been much greater had we similar results concerning other groups of men to compare with them. The inquiry ought, in fact, to have been conducted on the differential method, and directed to disclose the peculiarities of scientific men as contrasted with men in general, or with widely different groups. The labour of the inquiry must have been great as it is, and it may seem a heartless thing to say that Mr. Galton should have made it many times greater. But there would have been many advantages in collecting the fresh and unbiassed opinions of eminent men in many walks of life, not only of artists, musicians, engineers, but eminent lawyers, judges, administrators, scholars, divines. No doubt it is possible that some of these classes would have failed to appreciate the necessity for answering the queries addressed to them, and the answers might have proved scanty; but, if obtained, the comparison must have afforded most interesting results.

Though I have spoken of Mr. Galton's conclusions as being in some degree disappointing, it ought not for a moment to be supposed that they are not worth the trouble incurred by the investigator and his correspondents. It is the extreme difficulty of the problem attacked which makes Mr. Galton's efforts seem less successful than some might have expected. The origin of genius or conspicuous success is the last thing which will be explained in the long progress of science. All that ought to have been expected was that Mr. Galton might form some comparative estimate of the several component tendencies which usually contribute to its production. If we look to practical conclusions, the inferences to be drawn from the answers concerning education are alone worth all the labour spent upon the book. The fact that about a hundred of the leading scientific men of the day are mostly in favour of a wide and varied range of studies in the school and college curriculum, seems to me a conclusion of great significance.

W. STANLEY JEVONS

GREEN'S "HISTORY OF THE ENGLISH PEOPLE."

A Short History of the English People. By J. R. Green, M.A., Examiner in the School of Modern History, Oxford. With Maps and Tables. (London: Macmillan and Co., 1874.)

WE deem this work to come within the province of a scientific journal for two reasons:—First, Mr. Green, so far as we know, is the first who, throwing aside with just contempt the "drum and trumpet" method of writing history, has attempted to trace the various influences or forces that have combined to mould the English people and make them what they are at the present day; second, because he has noticed in detail certain important episodes in the history of English science. The only work we know of that approaches in plan the history of Mr. Green is Knight's "Pictorial History of England;" but it is only on the surface that any resemblance exists. Knight's history is divided into sections, each of which deals with one of the various ways in which English energy has found scope—in politics and war, in literature and science, in commerce, agriculture, religion, and social life; but no attempt whatever is made to show the result of the combined influence of the forces acting and reacting through these departments on the English people as a whole. In reality, the distinction drawn between these various spheres of human energy is as arbitrary as the distinction between ancient and modern history; one might as well attempt to show the resultant of any number of physical forces, by attending separately to the action of each, without paying any heed to their action in combination. Mr. Green deserves all the credit due to the originator of a bold and happy idea, and still greater credit for having worked out this idea with marvellous success. His history he calls a "short" one, but in the space of his 800 pages we venture to say he conveys a fuller and juster idea of the progress of the English nation than any previous author has done; nay, in very few instances has the whole life of any one period been more clearly and adequately set forth than will be found to be the case in these pages.

"At the risk," Mr. Green says in his preface, "of sacrificing much that was interesting and attractive in itself, and which the constant usage of our historians has made familiar to English readers, I have preferred to pass lightly and briefly over the details of foreign wars and diplomacies, the personal adventures of kings and nobles, the pomp of courts, or the intrigues of favourites, and to dwell at length on the incidents of that constitutional, intellectual, and social advance in which we read the history of the nation itself. . . . I have restored to their place among the achievements of Englishmen, the 'Faerie Queen' and the 'Novum Organum.' I have set Shakspere among the heroes of the Elizabethan age, and placed the scientific inquiries of the Royal Society side by side with the victories of the New Model."

Mr. Green begins his history in "Old England," as he happily calls Sleswick, the fatherland of the English people; and with charming clearness and simplicity and well-sustained enthusiasm, traces step by step their ever-widening development from the time the original conquering colonists landed in Kent down to the present century. Mr. Green's power of discovering and bringing into bold relief the true causes of events, and of exhibiting in few and telling words the real characters of the multitude of actors that have played their busy parts on the restless stage of English history, is rare. We can only repeat that his work is the only existing history of England that has been written on anything like scientific principles.

Throughout his work Mr. Green gives prominence to the intellectual development of the people; in an interesting section on the Universities, in chap. iv. (1215—1217), in conection with the origin and growth of Oxford, a masterly sketch is given of the life and work of Roger Bacon, and the premature birth of English scientific research. Again, in a chapter on "the Revolution," a more detailed and thoroughly intelligent account is given of the scientific work of Francis Bacon, and of the "Beginnings of English Science," including the birth of the Royal Society. These sketches show that Mr. Green has not only mastered his authorities, but is also perfectly competent to trace the various stages by which science has attained its present all-important position. And, as the world progresses, historians of this class will be more and more in demand, for if things hold on in their present course, it will become more and more clearly recognised that the only satisfactory history of a people is the history of the growth of science, in its widest sense, among that people.

As an example of Mr. Green's method and style, we quote the paragraph, in connection with Francis Bacon, on the "Beginnings of English Science":—

"It was this lofty conception of the position and destiny of natural science which Bacon was the first to impress upon mankind at large. The age was one in which knowledge, as we have seen, was passing to fields of inquiry which had till then been unknown, in which Kepler and Galileo were creating modern astronomy, in which Descartes was revealing the laws of motion, and Harvey the circulation of the blood. But to the mass of men this great change was all but imperceptible; and it was the energy, the profound conviction, the eloquence of Bacon, which first called the attention of mankind as a whole to the power and importance of physical research. It was he who by his lofty faith in the results and victories of the new philosophy nerved its followers to a zeal and confidence equal to his own. It was he who above all gave dignity to the slow and patient processes of investigation, of experiment, of comparison, to the sacrificing of hypothesis to fact, to the single aim after truth, which was to be the law of modern science. But, in England at least, Bacon stood- -as we have said—before his age. The beginnings of physical science were more slow and timid there than in any country of Europe. Only two discoveries of any real value came from English research before the Restoration; the first, Gilbert's discovery of terrestrial magnetism in the close of Elizabeth's reign; the next, the great discovery of the circulation of the blood, which was taught by Harvey in the reign of James. But apart from these illustrious names, England took little share in the scientific movement of the Continent; and her whole energies seemed to be whirled into the vortex of theology and politics by the Civil War. But the war had not reached its end when a little group of students were to be seen in London, men 'inquisitive,' says one of them, 'into natural philosophy and other parts of human learning, and particularly of what hath been called the New Philosophy . . . . which from the times of Galileo at Florence, and Sir Francis Bacon (Lord Verulam) in England, hath been much cultivated in Italy, France, Germany, and other parts abroad, as well as with us in England.' The strife of the time indeed aided in directing the minds of men to natural inquiries. 'To have been always tossing about some theological question,' says the first historian of the Royal Society, Bishop Sprat, 'would have been to have made that their private diversion, the excess of which they disliked in the public. To have been eternally musing on civil business and the distresses of the country was too melancholy a reflection. It was nature alone which could pleasantly entertain them in that estate.' Foremost in the group stood Doctors Wallis and Wilkins, whose removal to Oxford, which had just been reorganised by the Puritan Visitors, divided the little company into two societies. The Oxford society, which was the more important of the two, held its meetings at the lodgings of Dr. Wilkins, who had become Warden of Wadham College, and added to the names of its members that of the eminent mathematician, Dr. Ward, and that of the first of English economists, Sir William Petty. 'Our business,' Wallis tells us, 'was (precluding matters of theology and State affairs) to discourse and consider of philosophical inquiries and such as related thereunto, as Physick, Anatomy, Geometry, Astronomy, Navigation, Statics, Magnetics, Chymicks, Mechanicks, and Natural Experiments: with the state of these studies, as then cultivated at home and abroad. We then discoursed of the circulation of the blood, the valves in the *venæ lacteæ*, the lymphatic vessels, the Copernican hypothesis, the nature of comets and new stars, the satellites of Jupiter, the oval shape of Saturn, the spots in the sun and its turning on its own axis, the inequalities and selenography of the moon, the several phases of Venus and Mercury, the improvement of telescopes, the grinding of glasses for that purpose, the weight of air, the possibility or impossibility of vacuities, and nature's abhorrence thereof, the Torricellian experiment in quicksilver, the descent of heavy bodies and the degree of acceleration therein, and divers other things of like nature.'

"The other little company of inquirers, who remained in London, was at last broken up by the troubles of the Second Protectorate; but it was revived at the Restoration by the return to London of the more eminent members of the Oxford group. Science suddenly became the fashion of the day. Charles was himself a fair chemist, and took a keen interest in the problems of navigation. The Duke of Buckingham varied his freaks of rhyming, drinking, and fiddling, by fits of devotion to his laboratory. Poets like Denham and Cowley, courtiers like Sir Robert Murray and Sir Kenelm Digby, joined the scientific company to which in token of his sympathy with it the king gave the title of 'The Royal Society.'"

The maps, and without maps no history ought to be tolerated, will be found greatly useful. Should Mr. Green utilise the large amount of material he must have collected for the purpose of writing a similar history on a much larger scale, no doubt he will say something about the physical environment of the English people,—those external conditions which have had their own share in shaping the history and character of our nation. His present work ought to become the school history of England.

FEHLING'S NEW CHEMICAL DICTIONARY

Neues Handwörterbuch der Chemie. Unter Mitwirkung von Bunsen, Fittig, Fresenius, &c. Bearbeitet und redigirt von Dr. Hermann v. Fehling, Professor der Chemie in Stuttgart. Erster Band. (Braunschweig: Druck und Verlag von Friedrich Vieweg und Sohn, 1874.)

TEN years have passed since the completion of the great work of Liebig, Poggendorff, and Wöhler, the "Handwörterbuch der Reinen und Angewandten Chemie." These years have witnessed great changes in our chemical knowledge; not only have theories which in the year 1864 occupied but an inferior place in the general system of chemistry now come to the front, but also a vast array of new facts demands a place in the system, which must therefore be extended so as to include them all.

The book which ten years ago was looked upon by all as a standard authority has now necessarily become somewhat antiquated, and the desire for a new edition has naturally arisen in the minds of the German chemists. The first fruits of this desire we have now in the goodly volume of 1,200 pages which lies before us.

As in most of the productions of the German mind, so in this, there is no lack of thoroughness, nor of breadth of view and treatment of the subject. The names of the contributors of the various articles are alone sufficient to inspire trust in what they have to tell us. A few of that old band of chemists who made the first *Handwörterbuch* famous still lend their aid to the success of the present volume; while among the younger men are Fittig, Kekulé, Hofmann, Victor Meyer, Tollens, Zincke, and others, who have already made for themselves a name in science.

Whether this be the proper time for the publication of a large and all-embracing treatise on chemistry is perhaps a question which admits of more than one answer. Chemical theories at present seem to be nearing that stage at which they are to be embraced within the larger theories of mechanical science. If this be true, the interpretation to be put upon chemical facts will in some years be greatly modified, and hence the publication of somewhat elaborate treatises will be demanded. In such a volume, however, as this, we have the material out of which the chemist of the future will elaborate his general theory of chemical action; and not only this, but we have a storehouse from which the student of our science may draw rich supplies of knowledge, and to which he may always refer, well assured that he will not be sent away empty.

The arrangement of the new *Handwörterbuch* is very similar to our own "Watts' Dictionary." Amid the variety and excellence of the articles, it is difficult to choose any for special mention.

The articles on Equivalents and Atoms are especially to be commended, the former by Prof. Kekulé, the latter by Prof. Fittig. In the former article the author defines the correct and true meaning of the word "equivalent"; he shows how vague oftentimes are the grounds upon which we pronounce that such a substance is equivalent to such another, and he clearly points out the great advantages possessed by the modern atomic notation as compared with the old and vague so-called equivalent notation.

In the article on Atoms we have a clear and succinct account of the modern chemical theory, and an interpretation of the way in which the older ideas of equivalency are applied to the newer atomic doctrines.

The articles on Analysis are generally full and satisfactory. It is strange, however, that such an excellent method of qualitative testing as that presented by "Bunsen's Flame Reactions" should be overlooked.

There are excellent monographs on Aniline and Benzol, by Prof. Hofmann and Zincke respectively; while on such subjects as the Respiration of Animals and Plants, and Zoö-chemistry in general, we have articles from the pen of Prof. v. Gorup-Besanez. The woodcuts are admirable; in this respect the German work is far ahead of our English Dictionary. Let us hope that the work will be completed as promised in the prospectus, and that the volume already published will not add another to the already too long list of great German scientific works the opening volumes of which stand waiting for their successors, but seemingly waiting in vain.

M. M. PATTISON MUIR

OUR BOOK SHELF

Die fossilen Bryozoen des österreichisch-ungarischen Miocäns. Von Prof. Dr. A. E. Ritter von Reuss. I. Abtheilung. Pp. 50. 4to. (Wien: 1874.)

Geologischer Bau der Insel Samothrake. Von Rudolf Hoernes. Pp. 12. 4to. (Wien: 1874)

THESE publications are extracted from the Transactions of the Imperial Academy of Sciences. Dr. v. Reuss's paper describes the Salicornaridæ, Cellularidæ, and Membraniporidæ, a number of the species being new; and gives twelve excellent plates of the fossils. According to Herr Hoernes, the island of Samothraki consists of abrupt hill-masses of ancient crystalline rocks, such as granite, clay-slate, hornblende rock, &c., overlaid, especially in the north-west and north, with deposits of Eocene age, and diluvial and recent accumulations. A coloured sketch-map accompanies the paper.

Über die palaeozoischen Gebilde Podoliens und deren Versteinerungen. Von Dr. Alois v. Alth. Erste Abtheilung. Pp. 78. (Wien: 1874.)

Über die triadischen Pelecypoden-Gattungen, "Daonella" und "Halobia." Von Dr. E. Mojsisovics v. Mojsvár. Pp. 38. (Wien: 1874.)

BOTH these publications are issued by the Austro-Hungarian Geological Survey, being extracted from the "Abhandlungen, Band vii." This mode of republishing in a separate form the papers contributed to their Transactions cannot be too strongly commended. Dr. A. v. Alth's paper relates to the region which lies between the rivers Bug and Dnieper. It is illustrated by five lithographic plates of fossils, a number of which are new species of Pteraspis, Scaphaspis, Cyathaspis, Beyrichia, &c. Dr. Mojsisovics' paper is also illustrated by five lithographic plates of a number of new species of the genera Daonella and Halobia, which are described and named by himself.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

On the Inventor of Clock Movement applied to Equatorials.—Suum Quique

IN a pamphlet by Col. Laussedat, "On the Horizontal Astronomical Telescope," in which he claims for himself the invention of applying a heliostat to direct the light of any object into a fixed telescope, I find at p. 2 this statement in speaking of the equatorial: "The idea of so endowing a telescope with a moving power which annuls, or, to speak more exactly, compensates the motion of the earth, is due to a French watchmaker of the last century, named Passemont."

I am sure the distinguished writer would not knowingly have done to another the injustice of which in his own case he complains; but in fact this invention belongs to a much earlier date, and to one of far greater fame, the illustrious Robert Hooke, who describes it, with a figure, in his "Animadversions on the Machina Cœlestis of Hevelius" (my copy bears date 1674). It was primarily intended to facilitate the process of measuring directly the distance of two stars, a process which was then much in vogue, but which must have been very troublesome from the difficulty of following them. It consists of a strong polar axis, adjusted at its lower bearing by screws, and carrying at top a cross arm, one end of which bears a counterpoise, and the other a quadrant or sextant with a ball-and-socket support, by which its plane can be made to coincide with that passing through two stars. But Hooke expressly stated that a telescope may be similarly attached there. The polar axis carries an octant whose limb is ratched, and driven by a screw connected with a clock. The clock is regulated by a conical pendulum; and he describes the mode of altering its rate for the sun, moon, and planets. Of the date or details of M. Passemont's re-invention there is no trace in Lalande. But, as I find in Rees' Cyclopædia (art. "Passemont") that he was born in 1702, and that his first publication appeared in 1738, it is by at least half a century later than Hooke's.

It also deserves notice that Col. Laussedat's invention is described by Hooke in his treatise on Helioscopes two years later (1676). His words are: "I explained at the same time to the Royal Society several other ways of facilitating the use of very long glasses for other objects in the heavens (he had been speaking of the sun) by the help of one reflecting plate only, and that was by a tube fixed either perpendicularly, horizontally, or obliquely; for it mattered not, whether as to the seeing the object in any part of the heaven, and the object could be as easily found as by the common telescope of the same length. But of these elsewhere."

I have not, however, been able to find any further notice of it in his works.

This invention leads me to a suggestion which may be interesting to astronomers. The Royal Society possesses two Huyghenian object-glasses, one of 120 feet focal length, the other of 200. Some years ago a question was raised by M. O. Struve as to the defining power of the first-named of these, in reference to a discussion on the rings of Saturn, and the Society appointed a committee to examine. It was tried at the Kew Observatory, and defined a watch-dial as well as a good 3·75-inch achromatic. This was considered sufficient without incurring the great expense of such a scaffolding or building as would have been required to use it for celestial observations. These, however, can be easily managed by Col. Laussedat's arrangement. If successful, these object-glasses would probably give matchless solar photograms. The 120 feet has 6 inches aperture, and would give a solar picture 13·4 inches diameter. R.

The Potato Disease

I am afraid I cannot regard the letter of your anonymous correspondent "Inquirer" as written in altogether good faith. He first misrepresents what I stated in my letter of Nov. 20, which he professes to quote, and then proceeds to ask me a question which, if he had even glanced at my letter, he would have seen was already answered.

If I beg your indulgence for some further remarks suggested by "Inquirer's" letter, I hope that they will be the last it will be necessary to make.

The number of Nature for Nov. 19 gave what purported to be an account of the "Report of the Potato Disease Committee of the Royal Agricultural Society." It contained the following passage:—"Prof. de Bary has worked out the scientific questions that occur as to the origin of the disease. It is owing to a fungus (*Peronospora infestans*), which attacks the leaves first, and after absorbing the nutriment of them, utilises the petiole, and thus reaches the tubes" (*sic*). It appeared to me, as it did to others, that the only meaning which could be attributed to this was that we owed to Prof. de Bary all the knowledge we at present possess with regard to the disease.

I therefore thought it fair to point out in the following number "that all this and a good deal more was ascertained by the Rev. M. J. Berkeley in this country, and by Montagne in France, and published by the former in a paper contributed to the first volume of the Journal of the Horticultural Society in 1846." It is almost incredible that anyone with my letter before him should say that I had asserted "the *discovery* by the Rev. M. J. Berkeley of the fact that the potato disease was due to the attacks of a parasitic fungus," and should proceed to ask me for "a *more exact reference* to the records."

The potato disease appeared on the Continent a few years before it worked such ravages in the British Isles. The mould had been detected upon the foliage in France and Belgium, but opinion was divided as to the part it really played. And we have Mr. Berkeley's authority for asserting that even Montagne, to whom "Inquirer" attributes the discovery that the potato disease was due to the attacks of a parasitic fungus, did *not* support the "fungal theory."

In this country Mr. Berkeley maintained it almost single-handed against men of such weight as Lindley and Playfair. His paper, which appeared in the Horticultural Society's Journal in November 1845 (the whole volume is dated 1846), really, however, settled the matter.

It is perfectly easy to trace what Mr. Berkeley did by referring to the horticultural papers of the time. Thus, he wrote to the *Gardener's Chronicle*, August 30, 1845 (p. 593): "The malady by which potatoes are so generally affected this year, both in this country and on the Continent, does not appear to prevail in this neighbourhood. . . . I have this morning received from Dr. Montagne, of Paris, some leaves affected with the mildew. . . . The parasite of the potato does not appear to have been observed before by systematists." On Sept. 6 (p. 608): "You will be interested to learn that the mould upon the potatoes which you sent me is identical with that upon the leaves, and the same with what I have received from Paris. It appears, then, that *the decay of the tubers is produced by the same cause which affects the leaves*, viz., by the growth of a mould whose development has been promoted by excessive wet." On Sept. 20 (p. 640): "In every case I find the *Botrytis infestans* [now called *Peronospora infestans*] preceding the work of destruction."

All this is given with very full details by Mr. Berkeley in his later paper. What I wish, however, particularly to point out is that the admirable observation (contained in the words I have italicised) of the identity of the fungus which attacks the foliage with that which destroys the potatoes was made absolutely independently by Mr. Berkeley. Morren appears to have made it about the same time. It is a sufficient proof of the estimation in which his investigations were held at the time, that Montagne relinquished the intention of writing upon the subject, and transmitted his materials to Mr. Berkeley, by whom the use of them is duly acknowledged. W. T. Thiselton Dyer

Mr. Cuttell and Section Cutting

In your number of Nature just issued you have given an extract from the annual address of the President of the Royal Society, in which reference is made to my labour of section cutting. It is perfectly true that I have prepared more than a thousand sections of coal plants, but it would be unfair to a very efficient auxiliary not to mention the help he has afforded me in this work. I require many sections of a much larger size than my machinery is capable of cutting, and these have been prepared for me by the skilled hands of Mr. Cuttell, of New Compton Street, London.

In each of two instances, also, I am indebted to the same experienced lapidary for obtaining three sections out of small but precious fragments, not more than from three-sixteenths to a quarter of an inch in thickness. I am anxious to recognise these services, and not to monopolise Mr. Cuttell's share of the credit for the labours to which Dr. Hooker's report refers so kindly.

W. C. Williamson

Fallowfield, Manchester, Dec. 24

Snakes and Frogs

In reading the letter of your correspondent, Mr. Mott, on the cry of the frog, it struck me as curious that there should be resemblances which people in countries wide apart should pitch on the same phrase to indicate. Now, there could not be a better way of conveying a sound which frequently greets one's ears in the country in Bengal during the rains, than that which your correspondent makes use of, "the cry of a new-born infant." Few residents in the country here, we take it, who have lived anywhere near jungle, will have failed to hear, and that tolerably frequent, the unspeakably plaintive wail which indicates that the remorseless ophidian has seized his prey, and that deglutition has commenced. If one be tolerably quick he may, as I have frequently done, guide himself to the very spot by the sound of the frog, and the snake will then, in his alarm and anxiety to escape, frequently let the frog go, though he as often slides off with it protruding from his mouth. We have the batrachians in great force here, and of all sizes and noises, from the great swamp frog which, as soon as the lands are drenched in the heavy rainstorms of May, commences its nocturnal bellowing, down to the bronze tree frog with gilt eyebrows that keeps up its metallic tink.

The frog is connected with some of the religious ceremonies of the country; and one may see here, as well as in Assam, the curious custom of "bathing the frogs" in a cage. This is done in time of drought to propitiate the rain god. Grain is sometimes put out on a mat to sun, and to prevent the crows from making away with it, a frog is tied by the leg to a stake; his constant hopping about acts as a deterrent to the crow. Hence the native proverb denoting vicarious and unmerited suffering, "The crow steals the grain, and the string is round the leg of the frog." C. B.

Budderpore, Eastern Bengal

THE ANDERSON SCHOOL OF NATURAL HISTORY

Most of our readers, no doubt, have heard of the School of Natural History established by the late Prof. Agassiz, in conjunction with some of his American friends, shortly before his lamented decease. The first report of the trustees of this institution, which has lately been received in this country, gives a fuller account of its foundation and subsequent progress than has yet reached us.

The plan of the school was first put forward by its originator in a circular issued in December 1872, from the Museum of Comparative Zoology at Cambridge, U.S.A. It was proposed that courses of instructive lectures in various branches of natural history should be delivered by the sea-side, at Nantucket—an American bathing-place—during the summer months, by Agassiz himself, and by other naturalists belonging either to the same institution, or to other scientific establishments in the United States, who had combined together to assist him. The object of these courses was chiefly for the benefit of teachers proposing to introduce the study of natural history into their schools, and for such students as were preparing to become teachers. Besides the lectures it was proposed to provide a number of aquariums, as also the necessary apparatus for dredging in deep water, so that the pupils might be practically as well as theoretically instructed.

Whilst Prof. Agassiz was appealing to the public to support his beneficent scheme, the attention of Mr. John Anderson, a wealthy merchant of New York, was attracted to it. Mr. Anderson, "although not possessing himself any intimate acquaintance with natural history," "sympathised warmly" in the professor's project for making that department of science a branch of education, and in aid thereof offered to hand over to trustees for the benefit of the scheme a whole island situated in Buzzard's Bay, in Massachusetts.

We need hardly say that the munificent offer was gladly accepted, and Penikese Island, containing 100 acres of great fertility, several springs of fine fresh water, and a mansion house, constituting altogether a "most attractive location for a summer residence," became, instead of Nantucket, the seat of the proposed institution, which was appropriately named after the donor, the "Anderson School of Natural History."

A few days after the acceptance of this noble gift by Prof. Agassiz, Mr. Anderson gave a further proof of his liberality by presenting the sum of $50,000 for the equipment and current expenses of the institution, which was thus enabled to make a start under very favourable circumstances.

When matters had progressed thus far, it was hardly in accordance with the national characteristics that much delay should take place in commencing work. So, although the island of Penikese was only presented to Prof. Agassiz on the 22nd April, 1873, a site was selected for the school, the plans were arranged, and the contract actually signed for the necessary works on the 16th May, and the 8th July was appointed for the building to be ready. In vain the architect and builder declared that it was impossible, and urged the postponement of the opening until the following year. Prof. Agassiz, perhaps with a presentiment of the future, was inflexible, and a commencement was actually made on the appointed day. During the summer a second building, containing another numerous set of working rooms and dormitories and a lecture room connecting it with the former edifice, was nearly completed, together with the interior arrangements of the whole school.

During the first session, 1873, the pupils were from forty to fifty in number, consisting chiefly of teachers (both male and female) in colleges and schools and other public institutions. Prof. Agassiz lectured nearly every day. Mr. Galloup, a citizen of Boston, sent his yacht to Penikese, and handed it over to Count Pourtales, who took charge of the dredging parties during the whole session. Ten or twelve of the pupils went out every day, thus obtaining instruction in the use of the implements, and at the same time obtaining many specimens for the lectures which could not have been collected from the shore.

Other efficient workers were Dr. A. S. Packard, jun., Prof. Jordan, Dr. Brewer, Prof. Wilder, and Prof. Guyot. Full instruction was thus given in various branches of natural history, in geology, in physical geography, and especially in zoology.

So successfully was this scheme carried out, that for the succeeding session a much larger number of applications than accommodation could be provided for was received, when the untimely death of the founder occurred and somewhat imperilled the continuance of his noble plans. Fortunately, a worthy son succeeded to a worthy father, and under the direction of Mr. Alexander Agassiz, the Anderson School of Natural History has, we believe, continued in its career of prosperity, although details of its second year's working have not yet reached us.

When we consider what has thus been done in the United States, it is no slight reproach to us that nothing of the sort has been attempted in England. The great aquariums which have recently been built in several places offer unusual facilities for such an institution. But, alas! Brighton, Sydenham, and Southport are, we fear, wholly given up to ten per cent. The only counterpart of Prof. Agassiz in Europe is Anton Dohrn, whose "Zoological Station" at Naples is a worthy rival of the Anderson School of Natural History—perhaps even more complete in its organisation. We trust, however, that before long a similar scheme may be started in this country.

THE LAST TYPHOON AT HONG KONG

THE typhoon at Hong Kong of September 1874 is the greatest calamity that has visited the crown colony since its establishment in 1841. In each of the years 1859 and 1865 one of these desolating storms occasioned a great deal of damage to shipping in the harbour and vicinity; in 1867 two occurred, the second of which raged with great violence during the day, and was consequently observed with considerable interest; on Sept. 2, 1871, a still more striking instance is recorded;* but the whole of these phenomena sink into utter insignificance when compared with the furious typhoon which swept over the island during the night of the 22nd and the morning of the 23rd of September last. Without speaking of the dire effects produced by the latter, tenfold more terrible than any hitherto experienced, one far more crucial test may be adduced as evidence of the truth of our assertion.

It is an admitted fact that the force of the wind during a cyclone or typhoon is always in direct proportion to the height of the mercury in the barometer. Now, the lowest reading of the barometer previously recorded at Hong Kong was during the typhoon of 1871, viz., 29·15; whilst at Macao, on the same occasion, the mercury fell to 28·39. But during the recent event, the reading at Hong Kong at 2.15 on the morning of the 23rd was 28·75 according to one barometer, and 28·73 according to another; whilst at Macao the mercury actually fell to 28!—a fall we believe to have been altogether unprecedented in the history of atmospheric reading in China. Hence we conceive this to have been one of the most severe instances, if not the severest, of a typhoon on record. The fact that the readings *at Macao* were lower in 1871 than *at Hong Kong* in 1874 does not affect the question, for, as we shall see presently, the first-mentioned place always suffers more severely than the latter, owing to the greater concentration of the power of the wind *at its turning point*.

Many points of interest are connected with the late typhoon. It was observed that the clock upon the clock tower at Peddar's Wharf in Hong Kong stopped shortly after two, and it has been stated upon good authority that five or six other pendulum clocks stopped at the same hour. Now, this was exactly the time when the most violent throe of wind that was experienced throughout the entire night took place; hence we are justified in assuming that, at the precise moment when the typhoon was at its height, a shock of earthquake probably occurred, pointing to the conclusion that the atmospheric disturbance induced physical disturbances in the crust of the earth. The possibility of the existence of such a condition has been argued at length by Prof. Lyell in his "Principles," where he states that the inhabitants of Stromboli are said to make use of the island "as a weather-glass," its volcanic disturbances "increasing during tempestuous weather," so that "the island seems to shake from its foundations." He considers that extreme changes in the atmospheric pressure exerted upon a vast superficial area might well be deemed to influence the confined gases and liquids interposed between the successive layers of strata. That earthquakes are the result of movement amongst these gases and liquids there seems little reason to doubt.

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* See NATURE, vol. v. p. 166.

We gather, from the various accounts to hand, that the characteristics of the recent typhoon were very similar to those of the event of 1871, viz., that it came from an easterly quarter, and, after sweeping over Hong Kong, reached Macao somewhat later, there culminating; and, describing a portion of a circle so as to present all the appearances of a whirlwind, eventually dissipated itself along the coast upon contact with the high land. This typhoon, as might have been expected, crossed the estuary of the Pearl River from Hong Kong to Macao in less than half the time occupied by the typhoon of 1871. The distance is almost forty-five miles, and the lowest readings of the barometer were as follows:—In Hong Kong at 2.15 A.M. and at Macao at 3.15 A.M. during 1874, against 11 P.M. and 1.30 A.M. during 1871. The rate of progression in the late instance was moreover twice as great as that of the West Indian hurricanes, which has been computed at twenty to twenty-five miles per hour.

Before we dismiss the subject it may not be out of place to dwell for a few moments upon the probable causes which give rise to these "freaks of nature." At Hong Kong the S.W. monsoon blows from April to September, and the N.E. monsoon from September to April. It is during the *change* from S.W. to N.E. that typhoons usually occur. The theory is this. When the cold N.E. monsoon sets in suddenly it strikes upon a vast tract of land in Southern China, and on a portion of the China Sea warmed by the mild breezes of the opposite monsoon, occasioning rapid precipitation or condensation of vapours, and, as a necessary consequence, an extensive vacuum where the rarefied air formerly was. Other air then rushes violently in to fill the vacuum, and strong breezes, sometimes developing into typhoons, are the result. The mingling and collision of the various currents at their point of contact also assists the disturbance of the atmosphere. The reason of the gale as a rule blowing from the east is apparent. Inland of the coast line is a towering range of mountains, extending down to Cochin China, and effectually arresting the rush of air from that quarter. The open sea, therefore, is the only free point of access. The prevailing direction of typhoons at Hong Kong is, in point of fact, very nearly that of the N.E. monsoon just commencing, but possibly slightly diverted by the remaining influence of the opposite monsoon. Hong Kong, Amoy, and Macao being just opposite to the opening between Formosa and Luzon, the full sweep of the wind rushes in unhindered towards them from the Pacific Ocean. Macao, however, fares worst, for it is situated precisely where the typhoon is arrested by the high land of the coast. The lowest readings of the barometer are invariably therefore recorded at Macao.

ENCKE'S COMET

I HAVE received this morning, from the Observatory of Pulkowa, copies of Dr. von Asten's ephemeris of this comet, in which the accurate effect of planetary perturbation to the approaching perihelion passage (about April 13·0 Greenwich time) is included. His positions differ less than five minutes of arc from those I have already communicated. The comet arrives at its least distance from the earth on the night of May 3, about which time it may be a bright object for the observatories of the southern hemisphere. In these latitudes it will probably be observed, as in 1842, to the end of the first week in April. If not detected during the next period of absence of moonlight, as I believe to be probable, there can be no doubt of its visibility before the February moon interferes.

J. R. HIND

Mr. Bishop's Observatory, Twickenham, Dec. 22

FERTILISATION OF FLOWERS BY INSECTS[1]

IX.

Alpine Orchids adapted to Cross-fertilisation by Butterflies

NO family of plants, as far as is known, offers more various adaptations of flowers to insects of different orders than the Orchids, which have called general attention to the relation between flowers and insects since the admirable description by Mr. Darwin.[2] Of thirty-four species of Orchids found up to the present time in Westphalia, five[3] have been observed to be fertilised by humble-bees, and partly also by other Apidæ; two[4] by humble-bees and Diptera; one[5] by species of Andrena; one[6] by Vespa; one[7] by Apidæ, Diptera, and Sphegidæ; one[8] principally by Ichneumonidæ; one[9] exclusively by Diptera; two[10] by minute insects of different orders; and four[11] by Lepidoptera. Although the fertilisers of the sixteen remaining species[12] have not yet been observed, still it may fairly be deduced from the structure of their flowers that none of them, except, perhaps, *Habenaria viridis*, is fertilised by butterflies. Of thirty-four species, then, growing in the plain and lower mountain region, four, or at the most five, that is to say 12 to 15 per cent., are fertilised by Lepidoptera; whereas of five species of Orchids growing in the higher Alpine region near the Ortler, three,[13] or perhaps four,[14] that is to say 60 to 80 per cent., are adapted to cross-fertilisation by butterflies, a proportion which strongly corroborates my view that the predominant frequency of butterflies in the Alpine region must have influenced the adaptations of Alpine flowers. As two of these five species of Alpine Orchids are not mentioned in Mr. Darwin's classical work, nor have yet been described with regard to their contrivances for fertilisation, I will give here a brief account of them.

Gymnadenia odoratissima (Figs. 58, 59) produces its honey in a nectary only 3½ mm. in length, but the narrowness of its entrance (*n'* Fig. 59) proves it to be accessible only to butterflies. These, when inserting their proboscis into the nectary, cannot fail to attach to its upper side the two viscid discs (*d*, *d*) which lie close together immediately above the mouth of the nectary, and to which the pollinia are fixed by their caudicles. Hence a butterfly, when flying away from the flower first visited, bears a pair of pollinia upright on the upper side of its proboscis. When these are exposed to the air, the membranous discs to which their caudicles adhere contract (just as described and drawn by Mr. Darwin at p. 80 of his work), which causes the pollinia to move downwards and outwards in such a degree as exactly to strike the stigmatic surface when the butterfly inserts its proboscis into the nectary of a second flower.

Near the cataracts of the Adda, between the second and third Cantoniera, 2,200 to 2,400 metres above the sea-level, I found (July 14) plenty of these flowers, which, in accordance with their name, struck me by their highly attractive sweet smell; but although many butterflies were visiting a large number of the surrounding flowers, some of which were scentless, others but slightly scented,

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[1] Continued from p. 112.

[2] "On the various contrivances by which British and Foreign Orchids are fertilised by insects." London, 1862.

[3] *Orchis Morio*, *O. mascula*, *Epipogum Gmelini*, *Goodyera repens*, *Spiranthes autumnalis*.

[4] *Orchis maculata*, *O. latifolia*.

[5] *Cypripedium calceolus*.

[6] *Epipactis latifolia*.

[7] *Epipactis palustris*.

[8] *Listera ovata*.

[9] *Neottia nidus-avis*.

[10] *Gymnadenia albida*, *Herminium monorchis*.

[11] *Orchis pyramidalis*, *Gymnadenia conopsea*, *Platanthera bifolia*, *P. chlorantha*.

[12] *Orchis laxiflora*, *coriophora*, *militaris*, *fusca*, and *variegata*; *Habenaria viridis*, *Ophrys muscifera* and *apifera*; *Cephalanthera pallens*, *ensifolia*, and *rubra*; *Epipactis atrorubens*, *viridiflora*, and *microphylla*; *Malaxis paludosa*, *Liparis Loeselii*.

[13] *Nigritella angustifolia*, *Gymnadenia odoratissima*, *conopsea*, and *albida*; *Habenaria viridis*.

[14] *Nigritella angustifolia*, *Gymnadenia odoratissima* and *conopsea*, and perhaps *Habenaria viridis*.

Gymnadenia odoratissima remained almost entirely overlooked, some specimens of *Crambus coulonellus*, Dup.,* being the only visitors I succeeded in observing during several hours. As the possibility of self-fertilisation has been lost by the flowers of this plant, it must be supposed that its cross-fertilisation by insects happens frequently enough to make self-fertilisation useless. Therefore, from the rare diurnal visits and from the pale colour of the flowers, I am inclined to infer that *G. odoratissima* is more adapted to fertilisation by crepuscular and nocturnal than by diurnal Lepidoptera.

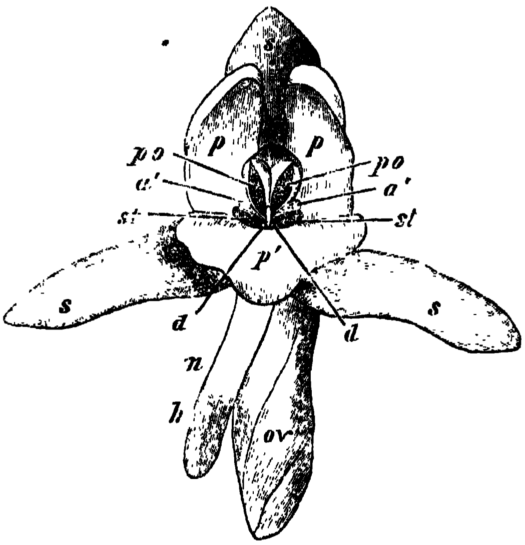

FIG. 58.—*Gymnadenia odoratissima.* Front view of the flower 7 : 1).

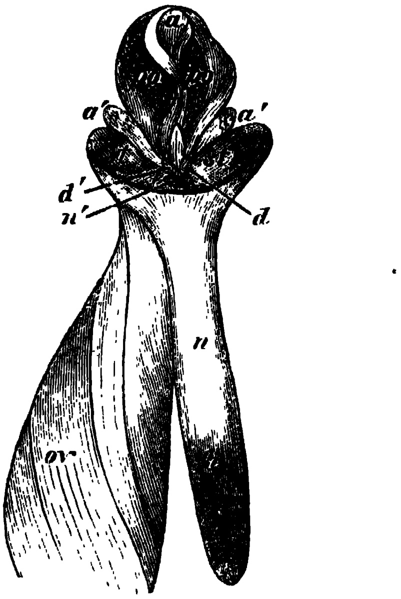

FIG. 59.—Front view of the same flower (14 : 1), with all the sepals and petals removed except the nectary.

(*ov*, ovary; *s*, sepals; *p*, *p*, petals; *p'* labellum, *a*, developed anther; *d d*, viscid discs; *a' a'*, rudimentary lateral anthers; *po*, pollinia; *st*, stigma; *n*, nectary; *n'*, orifice of the nectary; *h*, honey.)

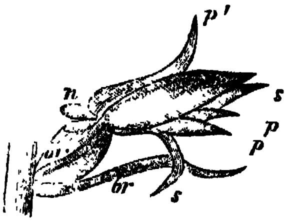

FIG. 60.—*Nigritella angustifolia.* Perfect flower viewed laterally, with the labellum (*p'*) in its natural position, upwards (3 : 1).

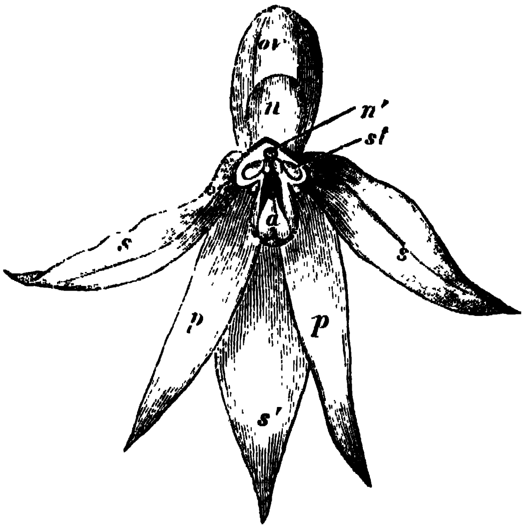

FIG. 61.—The same flower viewed in front, with the labellum removed (7 : 1).

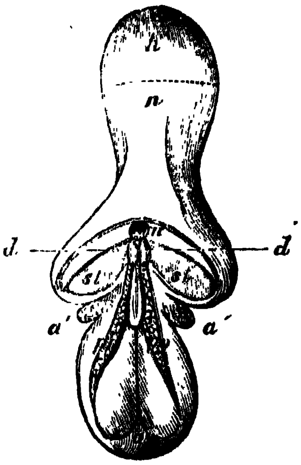

FIG. 62.—Sexual organs and nectary of same flower, in their natural position.

All letters have the same significance in Figs. 60, 61, 62, as in Figs. 58, 59. By the dotted line in Fig. 62 the limit of the honey is marked.

A curious observation on *G. odoratissima* remains to be noticed. In this species, as in most Orchids, the labellum (*n'*, Fig. 58), properly the upper petal, assumes its position as the lower lip by the torsion of the ovary; but in some specimens which I found, the torsion of the ovary had stopped half way in all the flowers, so that they occupied a transverse position, directing the labellum and the nectary to the right hand, one of the sepals downwards, the other upwards. A slight approximation to this position is shown by Fig. 59 if compared with Fig. 58. This exceptional imperfection of the torsion of the ovary of *G. odoratissima* seems to me to be of some interest, if we compare it with the normal condition of the flowers of *Nigritella angustifolia* (Figs. 60-62), in which the ovary is not at all twisted, so that the flowers occupy just the contrary position to what they do in other Orchids. In consequence of this also the function of the upper and lower sepals and petals is inverted; the labellum (*p'*), being turned upwards, here protects the organs of fructification, and the sepals and petals opposite to the labellum (*s'*, *p*, *p*, Fig. 61) afford a landing-place for insects. When a butterfly inserts its proboscis into the narrow entrance of the nectary (*n'* Figs. 61 and 62), it attaches the viscid discs (*d*, Fig. 62) to its under side; and when it flies away, the pollinia, in consequence of the drying up of the discs to which they are affixed, undergo an upward and outward movement so as to strike the stigmatic surface of the flower next visited. Nigritella has probably inherited the peculiar position of its flowers from the ancestors of the family of Orchids, which undoubtedly, like the most nearly allied families, possessed an untwisted ovary, and the imperfectly twisted condition of the ovaries of some individuals of *G. odoratissima* may be looked at as an effect of atavism.

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* According to Dr. Speyer's determination.

Nigritella differs from *Gymnadenia odoratissima* in the position of its flowers, and in being fertilised in the day-time. Whilst the latter seems to be fertilised especially by crepuscular and nocturnal Lepidoptera, the former, on the contrary, is easily seen to be fertilised by diurnal butterflies. In contrast to the pale flowers of *G. odoratissima*, those of Nigritella are of a dark purple red colour, shining magnificently in the sunlight, whilst at the same time they exhale so remarkable a vanilla-like odour that I have more than once recognised this species sooner by smell than by sight. I have never met with any other flower which attracts diurnal Lepidoptera more efficaciously than this. When descending from the pass of Flüela, towards Zernetz (July 9), during about an hour I collected in a small locality the following species, having observed them all fertilising the flowers of Nigritellas. (*a*) Rhopalocera: (1) *Lycæna semiargus* Rott., frequently; (2) *Melitæa Athalia* Rott.; (3) *Argynnis Euphrosyne* L.; (4) *Hesperia serratula* Ramb. var.? (*b*) Sphingidæ: (5) *Ino statices* L., Alpine varieties, in great number. (*c*) Noctuæ: (6) *Agrotis ocellina* W. V., several specimens; (7) *Prothymia ænea* W. V. (*d*) Crambina: (8) *Botys aërealis* Hb., var. *opacalis* H.; (9) *Diasemia litterata* Scop., in great number; (10) *Crambus dumetellus* H. var., very frequently. (*e*) Tincina: (11) *Butalis* species.* In the subnival region round "Quarta Cantoniera," besides Nos. 3 and 5, I observed (12) *Melitæa Parthenie* Bkh., var. *varia*; (13) *Zygæna exulans* Reiner, both not only perseveringly seeking for the honey of Nigritella in the sunshine, but also lodging after sunset in the heads of their favourite flower, from which in the evening and morning numerous individuals could easily be taken off which had been killed or benumbed by the cold.

HERMANN MÜLLER

THE TRANSIT OF VENUS

DURING the past week a few additional telegrams have appeared in the *Times*; these, with the *Times'* notes upon them, in a condensed form, we give here.

From the Hague we learn that the Government has received advices from the Dutch expedition sent to Réunion for observing the Transit of Venus. The sky being cloudy, the expedition was only partially successful.

The Astronomer Royal has received the following telegram from the Sandwich Islands:—

"Transit of Venus well observed at Honolulu and Atooi; cloudy at Owhyhee. Sixty photographs; Janssen failed; internal contact uncertain several seconds; complete disc of Venus seen twelve minutes before; 120 micrometer measures."

From New York intelligence has been received that the observation of the Transit of Venus made by the British astronomical party at Honolulu has been successful, except as regards the photographs, which failed.

It will be seen that the bad news for the English plans from New Zealand is fortunately not followed up from the Sandwich Islands. There the ingress, at one end of a base line stretching to Kerguelen's Land, has been secured, and if the observations have been successful at the latter place, Delisle's method can be applied for the ingress.

The telegram from New York is enough to give rise to some uneasiness. The first telegram stated that the Transit was well observed at Honolulu and Atooi, while there were clouds at Owhyhee; and then followed some statements which might have applied either to Owhyhee solely or to the whole attempt. From the last telegram we learn that the photographs failed at Honolulu, where in the telegram to the Astronomer Royal it was stated that the Transit had been well observed. There is, therefore, a distinct strengthening of the idea that the remarks "Janssen failed," "internal contact uncertain several seconds," apply to all the stations. We sincerely trust this may not be so, for the whole value, to the English plans, of the occupation of Kerguelen's Land is that observations of ingress may be made there to correspond with those made in the Sandwich Islands,—the ingress being accelerated in these latter and retarded at Kerguelen. A long experience with transits of Mercury and solar eclipses has now convinced astronomers that corresponding observations mean observations made by similar instruments under similar conditions. For instance, it will be useless to compare an eye observation of a contact made at the Sandwich Islands with photographs of the contact made by Janssen's beautiful contrivance at Kerguelen, whence we are not afraid of hearing that "Janssen failed," for Father Perry, in whose charge the revolving apparatus is, is one of the very few men long practised with astronomical instruments who form part of the English staff.

Lord Lindsay telegraphs to Lady Lindsay from the Mauritius:—

"Transit observed; last half satisfactory. Good photographs, measures, and time determination. Altogether well satisfied."

The private expedition of Lord Lindsay to the Mauritius deserved to succeed. We regret that the degree of success obtained is not so high as that which Lord Lindsay's energy, skill, and care had merited. Had observations been secured here and at Réunion at the *commencement* of the Transit, both Mauritius and Réunion would have been Delislean stations for observations of ingress—almost, indeed, as good as Kerguelen's Land, where it is to be hoped the official astronomers have obtained observations to pair with those made at the Sandwich Islands. But, as Lord Lindsay saw nothing of the beginning (ingress), and as the sky was cloudy at Réunion, the parties at Kerguelen's Land are now the only hope of the Delisleans, and this makes one regret all the more that the Americans were foiled in their attempt to occupy the Crozets. But Lord Lindsay's hopeful telegram evidently means that he has obtained enough photographs and measures to employ with advantage the direct and heliometric methods of determining the least distance of centres; these methods being precisely those which the German parties, also in the Mauritius, were to employ, obtaining corresponding observations at Chefoo, in the north of China.

The *Times* Malta correspondent writes under date Valetta, Dec. 15:—"The Transit of Venus was distinctly witnessed at Malta on the 9th inst. The external egress of the planet from the sun occurred precisely at 7.26 A.M. local mean time."

"*Melbourne, Dec.* 29.—Intelligence from New Zealand announces that the American astronomer, Prof. Peters, was successful in his observation of the Transit of Venus. The German expedition to the Auckland Isles also achieved satisfactory results."

THE SPECTROSCOPE AND THE TRANSIT OF VENUS

A RECENT article in the *Times* (Dec. 24) speaks of the application of the spectroscope to the observations of transits; it is so much to the point that we reproduce a portion of it here:—

The news from Malta which we gave yesterday of the unhoped-for observation of external egress there under good conditions, coupled with the further information which we published on Tuesday, detailing the care taken at Jassy to insure the accuracy of the observation of external contact at egress by Doctors Weiss and Oppolzer, furnishes a good opportunity of referring to the whole question of such contacts, and of pointing out an almost general omission in the scheme of observations. . . .

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* For all the names I am indebted to Dr. Speyer, of Rhoden.

A few general considerations will show how, in the opinion of some competent judges at all events, there is a remedy for such a state of uncertainty as we have described in the case of external contacts. We have first the essential consideration which underlies the various methods of utilising a transit, that when Venus is as near to us as she is on the occasion of a transit—Venus, of course, is always nearest to us when she is between us and the sun—unless she be exactly between us and the sun, so that we can use the sun as a screen or background, and see Venus moving like a black spot upon it, she will not be visible to us at all, as her bright side will be turned away from us. To point this statement we may remark that this is not the case with Mars, the path of which planet lies outside ours. Mars, in fact, is brightest and best visible when nearest to us, and his distance has been measured, as astronomers have just measured the distance of Venus, by using the longest possible base line on the earth and determining the apparent change of place of Mars among the stars as seen from the opposite points, thus using the stars as a background. The processes, it is true, are different in their details, but the same in intention. The special observations of ingress, egress, nearest approach to sun's centre, and the like, in the case of Venus, arise out of the fact that the only available screen is a limited one and of a certain shape, and, it may be said, are so many contrivances which enable us to use the centre of the sun's disc, as we use a star in the observations of Mars. In either case, of course, whether we determine the distance between the earth and Mars or the earth and Venus, we determine the distance of the sun and the dimensions of the whole solar system.

Now, within the last few years it has been established that the sun, with its sensibly circular boundary which we see every day—the screen which we use in the case of transits of Venus—is by no means the whole of the sun; it is only the central brighter portion of it. An exterior nebulous mass, feebly luminous compared with the central one, lies outside it, and in consequence of its feeble light it is quite invisible to us, except during total eclipses of the sun, when the moon cuts off the brighter light of the central portion, and allows us to see the exterior, irregularly-bounded one, extending for hundreds of thousands of miles away into space in all directions.

Although, as we have said, this exterior portion cannot be seen, except during eclipses, in consequence of the strong illumination of our atmosphere near the sun's place, the lower brighter parts of it can yet be rendered visible without an eclipse by the use of a spectroscope, and it is no exaggeration to say that by the aid of this instrument a large part of the sun outside that part of it ordinarily visible can be seen as sharply and as conveniently as any part of the sun's surface can be observed by a telescope.

The method by which this is accomplished will be easily understood by anyone who will take the trouble to look at the flame of a candle, the wick of which has been almost covered with common salt, through one of those "drops," triangular in section, which form part generally of a common lustre or a chandelier. A small prism will, of course, be better still. If the "drop" or prism be held close to the eye and upright, some four or five yards from the candle, at such an angle that the flame can be seen through it, a perfect yellow image of the wick and flame will be seen. Besides this image there will be a blaze of colour to the right and left of it, but the yellow image of the flame will be brighter than the rest.

Now, common salt is a compound of sodium with chlorine, which compound is decomposed by heat; and it is the vapour of the metal sodium set free which gives us, at the heat of the candle flame, light of one colour only, which cannot be dispersed or split up by the prism. The flame of the candle, on the other hand, gives out white light, which, being composed of light of all colours, is split up by the prism; so, while the prism has no action on the one, it has an enormous action on the other, and as a result gives us a perfect image of the flame, built up by the simple light of sodium vapour, brighter than the spectrum of the flame itself in that region. Further, the white light of the candle gives us no clear image, because in fact there are millions of images of every tint superposed; so that we get but a confused rainbow effect, due to the white light. The exquisite sodium image of the flame is due to the fact that there is no overlapping; and again, the reason that the addition of the salt to the flame, while it scarcely increases the light of the candle, gives us a spectral yellow image brighter than the background, is easily explained by the fact that in this part of the spectrum, as the coloured band is called, the sodium light is helping the yellow light of the flame, which gets no such help in other parts of the spectrum.

Now, we know as a matter of fact that the exterior regions of the sun give a spectrum similar in character to that given by the sodium vapour in the candle flame, and that the sun itself gives us a spectrum similar to that of the ordinary flame of the candle, and that it is because our air is illuminated by light of this kind stronger than the light of the external part of it that it is invisible to us.

To see, then, the external regions of the sun to which we have referred, the physicist looks at them through a prism, as in the candle experiment; in fact, he uses many prisms to spread out to the utmost the sun-light reflected to us by our intervening atmosphere, which sunlight, as we have seen, has a spectrum similar in its nature to the spectrum of a candle flame. When he has done this he sees the images of the strange forms in these external regions, as the yellow image of the candle was seen, the light producing which was concealed by the brighter light of the flame till the prism was brought into play. Of course, he knows now exactly in what part of the spectrum the light which they give out is to be found. He knows that all round the sun there is an atmosphere of vividly bright hydrogen, the light of which is red; he therefore looks in the red part of the spectrum, and the atmospheric veil being withdrawn by the prism in the way we have stated, he is enabled to trace by the red light given out by the hydrogen exactly what the hydrogen is doing, and where it exactly is. He knows that magnesium is sometimes ejected from the sun with terrific force into this sea of hydrogen, and he knows that the light of magnesium vapour is green, so he examines the green part of the spectrum and so observes the exact size and shape of these volcanic bursts of magnesium vapour.

We then come to the point of this long digression. When we bring the spectroscope into play the sun is made larger; outside the round disc there is discovered a continuous envelope extending to various heights, which we can observe. Our screen, therefore, is increased, and exterior contacts are exterior contacts no longer, if we can manage to see Venus passing over the newly-discovered region before she reaches the disc.

How, then, can this be accomplished? There are three ways in which this can be accomplished. We have first that ordinarily employed in observations of the chromosphere—as the newly-discovered region which surrounds the sun and can be spectroscopically observed without an eclipse is called. We have next a method devised by

Father Secchi; and still a third, independently hit on by several investigators.

In the method ordinarily employed, in order to avoid as much as possible the overlapping of images of sensible breadth (which prevented the white light of the candle flame from giving us even a distant approach to a pure spectrum), the light is allowed to fall on the prism through a very fine slit of a certain height. On this slit an image of the sun is thrown by a fine telescope. If the whole length of the slit is immersed, so to speak, in this image, we shall see nothing but the spectrum of the part of the disc which falls on the slit. If it is only half immersed in it, we shall see less of the spectrum of the disc, but we shall see also the spectrum of the chromosphere, as the obliterating effect of the reflection of the sunlight by our air has been destroyed by the prisms.

This spectrum will consist of bright lines, and if we can manage to place the slit on the precise spot occupied by Venus the lines will be broken, as the chromosphere will be eclipsed in this part by the planet; and we can follow the planet's motion until the break in the line travels down to the spectrum of the sun; this will mark the instant of exterior contact at ingress. At egress the problem is simpler, as the actual place occupied by the planet prior to external contact can be seen by an observer set to watch the sun's image on the slit of the spectroscope.

An obvious objection to this method, if a better one can be found, lies in the fact that Venus has, as it were, to be "fished for" prior to external contact at ingress, and that the slightest error in following the planet's motion would render the mode of observation useless.

The next method is one devised by Father Secchi. Using a spectroscope as before, instead of throwing a simple image on the slit, by an object-glass merely, he throws a spectrum of the sun on the slit by means of prisms, placed either before the object-glass or between it and the slit. He states that by this method the solar disc is seen with its spots and edge quite clearly defined, and that the spectral lines of the chromosphere are also seen. Further, the slit can be opened wider with advantage than under the first method. It is clear, therefore, that when Secchi's method is employed, if it does all that he says it does, observations of exterior contact would be easy.

The third method is a photographic one, and if it succeeds at all would do away with the main objection to the first two. A reference to the candle experiment will make it quite clear. If we imagine for a moment the white light of the ordinary flame of the candle to be abolished, it is clear that we should see nothing but the pure yellow image due to the monochromatic vapour of sodium. Similarly, if we imagine the light of the sun abolished, we should see the whole ring of the chromosphere if we looked at it through a simple prism, *as a ring*, or as a series of rings, according to the kinds of light given out by the vapour of which it is composed (the rings taking the place of the lines when we use a slit). In this way the chromosphere and the coronal atmosphere which lies outside it were actually seen in their true ring-like form by Prof. Respighi and Mr. Lockyer in the Indian eclipse of 1871, the light of the sun being temporarily abolished by the interposition of the moon.

In the third method, then, instead of a slit, a disc is used. All the sun is thus hidden, with the exception of a very small ring at the extreme edge, underlying the chromosphere. It is certain that the whole ring of chromosphere can thus be photographed every day the sun shines, as it is now observed on every such day by Mr. Seabroke at the Temple Observatory at Rugby School; and it is believed that the lower surface of the chromosphere can be thus photographed as *hard* as the outline of the sun itself, for there are many favouring conditions which, however, it would take us too long to enter upon in this place.

It is clear that by the application of this method there is a possibility of obtaining a whole series of photographs both before and after Venus is seen on the sun, and it is also clear that the method can only be tested on the occasion of a transit.

We know that Lord Lindsay's expedition, which has been organised with a completeness which puts our official programme into the shade, is to test Secchi's method, and that Dr. Janssen was to use some spectroscopic combination. The Italian parties, as we have already mentioned, were to limit themselves to external contacts as observed by the spectroscope, but their Government subsidy came so late that it is certain they were not equipped in the most complete manner, and it is probable that their original programme has been considerably curtailed.

Although the spectroscope forms no part of the equipment of the English parties, as it certainly should have done, seeing that they intended to observe contacts more than anything else, we may still hope that some of the methods will have been tested, and that the value of the aid they bring to observations of external contact may be determined.

NOTES

THE Belgian Academy of Sciences have conferred upon Prof. Huxley, Sec. R. S., the dignity of Foreign Associate. Such a step on the part of so very Catholic a body may make amends for the anathemas of the Irish prelates.

WE are glad to be able to contradict a statement which has appeared in some of the papers that Prof. Bunsen was about to leave Heidelberg. He has, we learn, no intention of doing so. The loss of Professors Kirchhoff and Königsberger is one which this University will feel most severely, and we cannot help wondering what the authorities at Carlsruhe were about to render it possible for two such men to be tempted away. Prof. Kirchhoff has declined the directorship of the Solar Observatory at Potsdam, and goes to Berlin as free Academician and as Professor in the University; Prof. Konigsberger has accepted the post of Professor at the large Polytechnic School in Dresden.

THE scientific results to be obtained from Arctic exploration will be carefully attended to in making the arrangements for the forthcoming Arctic expedition. Each officer will take up a special branch of scientific investigation, and will devote himself, during the interval between his appointment and the sailing of the expedition, to acquiring such knowledge as will enable him to exert his energies most usefully. There will also be a civilian naturalist or geologist in each ship, who will be carefully selected with reference to special knowledge and other qualifications. It is possible also that an Engineer officer may accompany the expedition, with charge of magnetic and pendulum observations. Some of the men forming the ships' companies will also be selected for their special qualifications. Among these, a dog-driver, named Karl Petersen, formerly cooper at the Danish settlement of Upernavik, has already been entered. There will also be three ice quarter-masters in each ship, chosen from the crews of the whalers, and one of the first duties of Capt. Markham on his arrival in England will be to proceed to Dundee for the purpose of selecting and entering these men. Capt. Markham was telegraphed for to Lisbon on the 20th, and is expected to arrive in London this week.

LIEUT. BELLOT, brother of the unfortunate Bellot, the Arctic explorer, to whom we alluded in a recent number, has obtained leave from the French Government to volunteer for the English Arctic Expedition.

ON Dec. 11, at 4.45 A.M., a severe shock of earthquake was felt by Gen. Wansouty and two friends, who intended to spend the whole of the winter on the top of the Pic du Midi, one of the highest summits of the Pyrenees. It is curious to notice that at the same moment, Dec. 10, 10.30 P.M., a similar shock was felt in America, round Winchester, on the Washington heights, alongside the banks of the Hudson. Are these two commotions related to each other?

THE weather has lately been so dreadfully boisterous in the Pyrenean ranges that the Meteorological Observatory situated near the crest of one of the peaks has been almost demolished, Gen. Wansouty and his two friends being obliged to leave the place on the 18th at daybreak. They managed to reach on the same day at midnight, after sixteen hours travelling in the snow, a small inn at Grisp, where they received every attention and were quite safe.

THE advices from the south are unanimous in stating that unprecedented masses of snow have fallen, not only in the Pyrenees and the Alps, but also in Spain, where they have put a stop to the warlike operations. On Thursday, Dec. 24, a thaw occurred in Paris, as well as in London and many other places, with an unprecedented rapidity.

THE number of railway accidents which befell English travellers on Christmas-eve has created quite a sensation in France. It is worthy of notice that in that country there is a regular staff of accomplished engineers, duly qualified by previous instruction, and paid by the Government to inspect the several lines and ascertain whether all proper measures for security have been taken by the companies. Nothing is left to haphazard, but everything is subject to a close and severe examination. The consequence is, that although the traffic on certain French lines is not less than on some of the main English ones, the accidents are less frequent and not attended with such disastrous results.

IN reference to the fact that German plants were found in French soil after the German invasion, we may state that a similar phenomenon has been observed before. *Lepidium draba* was introduced into England by the English troops who failed in the attempt to land on Walcheren in 1809. The gain from the herb was probably greater than the loss from the war. In 1814 many plants from the Don became acclimatised in the Rhone valley and vicinity of Paris. The most notable improvement on record of any spontaneous flora is perhaps the addition to the Alsatian grasses by the introduction of Algerian species. These plants, although coming from a warm climate, have secured a firm footing in their new home, and rendered fertile a number of places which had remained up to that time barren and fruitless.

ON Dec. 23, the French Geographical Society, under the presidency of Admiral La Roncière le Nourry, held its annual dinner. Toasts were drunk with enthusiasm to the union of nations by science, and to the crew and officers of the *Challenger.*

AT the last meeting of the Paris Academy of Sciences, M. de Lesseps announced the capture of a female shark in the Suez Canal, containing in its abdomen (?) twelve young sharks, all living, and varying in length from twenty to twelve centimetres. This fact, adds M. de Lesseps, tends to show that the shark is truly viviparous.

A FEW days ago the French Government received from Belgium four hundred carrier pigeons presented by a columbophile of that country. These animals will be sent to the acclimatisation gardens, where a central dove-house is to be erected for the Ministry of War.

IN the printed book department of the British Museum, constant complaints have been made for years by the *employes* regarding the injurious effect of the atmosphere on their health. Quite recently Mr. Warren, head of the transcribing department, has died, apparently from no other cause than the poisonous effect of the foul air he was compelled to breathe for many hours every day. His frequent complaints were listened to with apathy by his superiors, and notwithstanding the medical testimony by which he was backed, no attempt was made to remedy the evil. Mr. Warren's is a very hard case. He was only thirty-eight years of age, and leaves a widow and two young children, besides others who were dependent on him for the means of life. He had been in the Museum for twenty years, was a most efficient *employé*, and a general favourite. We hope the attempt which is being made to get a pension for his widow from the Civil List will be successful. He, however, has not been the only sufferer. The young men in his room are all more or less affected, some of them being under medical care. We certainly think that an investigation ought to be made into the justice of the frequent complaints as to the bad ventilation of many parts of the Museum, not even excepting the spacious reading-room. It is even said that had it not been for this cause, the accomplished Emanuel Deutsch might yet have been among us. Indeed, it is hinted that the entire management of the printed book department requires looking into; the public money being by no means spent there to the best advantage.

A VERY interesting letter appears in Monday's *Times* from a correspondent on board the *Challenger*, describing the voyage from Cape York to Hong Kong. Details are given of visits to several islands in the Malay Archipelago, in which collections of animals and plants were made. The results so far are said to be very satisfactory, and the *Challenger* has arrived in port with every store bottle and case in the ship filled up. With regard to the temperature of these eastern seas visited by the *Challenger*, the *Times* correspondent says:—"They are, in fact, a chain of sunken lakes or basins, each surrounded and cut off from the neighbouring waters by a shallower rim or border. The water, down to a depth equal to that on the border, is able to circulate freely, and gradually cools as we descend; but the whole mass below, having no means of communicating with the outer waters, remains at the same temperature as that of the water flowing over the floor of the rim; or, in other words, the icy-cold water travelling north along the floor of the ocean from the Antarctic Seas, which is found in all the deep open channels, cannot obtain admission through or over the surrounding rim. Thus, we can now affirm with certainty that the sea immediately east of Torres Straits, although having a depth of 2,450 fathoms, is surrounded by an elevated rim, having no deeper water over any part of it than 1,300 fathoms, all the water below that depth being at a steady temperature of 35°. The Banda Sea, which is 2,800 fathoms deep, is cut off at a depth of 900 fathoms; the Celebes Sea, which is 2,600 fathoms deep, is cut off at a depth of 700 fathoms; the Sulu Sea, which is 2,550 fathoms deep, is cut off at a depth of only 400 fathoms, all the water below that depth being at a temperature of 50°. On the other hand, we find that the Molucca passage is open to at least the depth of 1,200 fathoms, and the China Sea to 1,050 fathoms, the greatest depth yet obtained in them."

THE following is a list of the Council elected at the recent anniversary meeting of the Institution of Civil Engineers:—President, Thomas Elliot Harrison. Vice-presidents—William Henry Barlow, F.R.S., John Frederick Bateman, F.R.S., George Willoughby Hemans, and George Robert Stephenson. Members—James Abernethy, Sir William George Armstrong, C.B., F.R.S., Sir Joseph William Bazalgette, C.B., George Berkley, Frederick Joseph Bramwell, F.R.S., George Barclay Bruce, James Brunlees, Sir John Coode, William Pole, F.R.S., Charles William Siemens, D.C.L., F.R.S., Sir Joseph Whitworth, Bart., F.R.S., and Edward Woods. Associates—Major J. M. Bateman-Champain, R.E., John Head, and Col. Charles Pasley, R.E.

FROM the Indian papers it appears that the expedition despatched from British Burmah to Yunan was to travel, not by any new route, but by the one which Major Sladen followed some six years ago. It was to start, in fact, from his point of departure, Bhamo, proceeding thence to Momein and Talifu. From the last-named city, once more subject to a Chinese governor, it will sail down the mighty Yangtse, with Shanghai for its final goal. The exploring party is commanded by Col. Horace Browne, one of the most distinguished officers of the Burmah Commission. Mr. Ney Elias is a member of the expedition, and Dr. John Anderson, who goes as scientific officer, with a small staff of Eurasian and native collectors, is already well known as a member of the former expedition to Bhamo and Yunan. If the present party succeed in reaching Shanghai, they will be the first Europeans who, at least since the days of Marco Polo, have ever made their way through China from the West.

IT is with somewhat mingled feelings that we have perused the Report of the "Botanical Locality Record Club" for 1873. Any addition to our knowledge of the geographical distribution of British plants is very valuable, and the Recorder and his correspondents have industriously compiled much useful and interesting observation. But what chance remains of the permanence of our rarer plants when their localities are published in this way? We are glad to find that one of the rarest and most interesting of British plants, the Lady's Slipper, *Cypripedium Calceolus*, has been found in several other localities in the woody magnesian-limestone denes of Durham, besides the original one of Castle Eden; the exact spots are wisely withheld.

MR. R. ROUTLEDGE, B.Sc., F.C.S., has been appointed to the Professorship of Natural Philosophy at the Bedford College, York Place. Lecture rooms and a chemical laboratory fitted with the requisite appliances for the practical teaching of physical science are in course of preparation; but pending the completion of these, arrangements have been made to commence the next session with an elementary course of experimental lectures on heat, in another apartment of the College.

SURGEON-MAJOR DAY, F.Z.S., Inspector of Fisheries in India, has recently issued a second report on the fisheries of India and Burmah, which treats of the sea fisheries of those countries, and of the principal customs affecting the supply of fish. The case of the fisheries in the East is entirely different from that in this country. In India, the chief subject of investigation is how to augment the working of the sea fisheries; in Great Britain, one of the main objects of the Legislature in the various inquiries that have been made has been to see if they were being overworked, and to devise means for their preservation and protection. Although certain customs exist which, if observed on a large scale, would seriously affect the fisheries of India, still the general facts seem to prove that there are not sufficient means for properly capturing and utilising the natural supplies of fish. One of the principal defects is the want of quick means of carriage of the fish to the inland towns; to secure a supply of fish in the interior, it is necessary to salt them, and a great impediment to the trade in salt fish is the Government tax on salt. On this point Dr. Day's remarks are very important. He says: "It may be well to decide whether it is humane or even prudent, in a sanitary point of view, to make the price of salt so excessively high that it cannot be used to preserve fish with, and thus compel the people to go without or consume it putrid or rotten. We read that 'in Bergen there are two large hospitals devoted exclusively to the treatment of patients suffering from a peculiar form of disease brought on by eating badly-cured fish; the disease is a mixture of leprosy and elephantiasis' (both common in Orissa). In Ireland, in 1645, we are told that the leprosy was driven out of Munster by the English, the disease being due to the people eating foul salmon or those out of season. This was prohibited, and the prohibition enforced 'whereby hindering these barbarians against their will to feed on that poisonous meat; they were the cause of that woeful sickness which used so mightily to reign among them, but hath in time been almost abolished.' The collector of Ratnagiri states that the high duty on salt is undoubtedly a source of epidemics and other serious illnesses induced by eating imperfectly prepared fish. I think the foregoing extract sufficient to show that compelling a population to eat rotten fish may be a rather impolitic act."

THE Council of the Society for the Promotion of Scientific Industry, the head-quarters of which are at Manchester, has decided to give gold, silver, and bronze medals for excellence and novelty in the various classes of exhibits at the exhibition of implements, machines, and appliances for the economising of labour, which is to take place in Manchester in 1875. The arrangements for the Exhibition are progressing satisfactorily, and space has been secured by many high-class engineering and other firms.

THE tenth number of the third volume of the Bulletin of the Museum of Comparative Zoology consists of an article on the *Ophiuridæ* and *Astrophytidæ*, old and new, by Theodore Lyman, in continuation and rectification of previous memoirs on the same subject. Many new species are indicated, principally from the Philippine Islands, where they were collected by Dr. Semper, from whom they passed into the possession of the Museum of Comparative Zoology. The memoir is illustrated by seven plates, showing the anatomy of the *Ophiuridæ*, the growth of spines, hooks, and stumps, the formation of armed spines, &c., and the characters of the new species.

THE additions to the Zoological Society's Gardens during the past week include two Hardwicke's Mastigures (*Uromastix hardwickii*) from India, presented by Lieut.-Col. C. S. Sturt; a Nicobar Pigeon ((*Calœnas nicobarica*) from the Nicobar Islands, presented by Capt. R. J. Wimberley; two Bonnet Monkeys (*Macacus radiatus*) from India, presented by Mr. L. Miller and Miss J. Watt; two Mazame Deer (*Cervus campestris*) from South America, purchased; a Paradise Whydah Bird (*Vidua paradisea*), a Pin-tailed Whydah Bird (*Vidua principalis*) from West Africa, received in exchange.

THE PRESENT CONDITION OF THE ROYAL SOCIETY

(*Extracted from the President's Address at the Anniversary Meeting.*)

IT has been represented to me that, the Royal Society being now, after eighteen years of temporary accommodation, settled in quarters of which we hope to retain undisturbed occupation for some generations to come, an account of the present position of the Society in respect of our more important possessions, foundations, and functions, and our relations to the Government, would not only be generally acceptable, but might even be required of me by that large and increasing class of Fellows who live far from our doors. This class now numbers as nearly as possible one half of the Society, few of whom can be even occasional attendants at our meetings; and if to this class of absentees be added the large number of residents within the metropolitan district whose avocations prevent their attending, it will not surprise you to hear that (as I have ascertained by careful inquiry) a very large proportion of our fellow members know little of the Society's proceedings beyond what appears in our periodical publications, nor of our collections, nor of the tenure under which we occupy our apartments under the Crown—and that many have never heard of the funds we administer, whether our own or those voted by Parliament in aid of scientific research, nor of the fund for relief of the necessitous, nor of the gratuitous services rendered by the Society to various departments of the Government.

Unlike the great Academies of the Continent, the Royal Society has never published an almanack or annuaire containing information upon its privileges, duties, constitution, and management. Particulars on these points are for the most part now accessible to the Fellows only by direct inquiry, or through the Council Minutes; and these, to non-resident Fellows, are practically inaccessible. In my own case, though I have long been a resident Fellow and had the honour of serving on your Councils for not a few years, it was not until I was placed in the position I now hold that I became aware of the number and magnitude of the Society's duties, or of the responsibility these impose on your officers.

It is upwards of a quarter of a century since an account of the foundations that then existed and the work the Society then carried on was published in Weld's valuable but too diffuse "History of the Royal Society." These have all been greatly modified or extended since that period; and many others have been added to them; so that the time has now arrived when a statement of the large funds applicable to scientific research which the Society distributes, the conditions under which these are to be applied for, and other particulars, might with advantage be published in a summary form and distributed to the Fellows annually.

Finance.—After the financial statement made by the auditors, you will, I am sure, conclude that there is no cause for apprehension in respect of the Society's funds or income; and when to this I add that the expenses of removal from the old house, including new furniture, amount to 1,300*l.*, and that the volume of Transactions for the present year will contain eighty-six plates, the largest number hitherto executed at the Society's cost within the same period, you will also conclude that there is no want of means for providing illustrations to papers communicated to us for publication.

The landed property of the Society, as stated in the printed balance-sheet now before you, consists of an estate at Acton, in the neighbourhood of London, and an estate at Mablethorpe, Lincolnshire, each yielding a good rental. The Acton estate, at present on lease to an agricultural tenant, is planned to be let as building land, for which it is favourably situate, and will thus become increasingly valuable.

The subject of the tenure under which the Society holds the apartments we now occupy was brought up on a question of insurance. That question has been satisfactorily settled by reference to the Treasury; but it may still be worth while briefly to state the facts which the Council considered as furnishing valid grounds for appealing against the requirement to insure, and for at the same time requesting an assurance that the permanence of our tenure is in no way weakened by our removal to this building. These are: that when the apartments in Somerset House were originally assigned to the Society by command of George III., they were granted "during the pleasure of the Crown, without payment of rent or any other pecuniary consideration whatever;" that the Society was not required to insure either in Somerset House or old Burlington House; that when the Society removed at the request of the Government from Somerset House and accepted temporary accommodation in Burlington House, it was under the written assurance of the Secretary of the Treasury, addressed to the President of the Society, that the claims of the Society to "permanent accommodation should not be thereby in any respect weakened;" that in the debates on the estimates in 1857, the Secretary of the Treasury stated, in his place in Parliament, that "the Society could not be turned out of Somerset House without its own consent," and that "it was entitled to rooms by royal grant."

To this appeal the Lords Commissioners returned a satisfactory answer; and their letter, dated October 27th last, assures us "that there is no intention on the part of the Treasury to alter the terms on which the Royal Society holds its appointments under the Crown; the conditions of the Society's tenure will therefore be the same as those on which it occupied rooms in Somerset House, and was subsequently transferred to Burlington House."

While feeling it my duty to lay these details before you, I must accompany them with the assurance that nothing has occurred during this correspondence to disturb the unbroken harmony that has existed between her Majesty's Government and the Royal Society, ever since our occupation of apartments under favour of the Crown.

On every occasion of change of quarters the Society has received abundant proofs of the regard shown by the Government for its position, requirements, and continued prosperity; and there is, I am sure, every disposition on the part of the Government to recognise the fact that the privileges conferred on the Society are fully reciprocated by the multifarious aid and advice furnished by your Council in matters of the greatest importance to the well-being of the State.

The practice of electing Fellows of the so-called privileged class whose qualifications were limited to accident of lineage or political status, has been viewed with grave dissatisfaction by many, ever since the election of ordinary Fellows was limited to fifteen. The Council has in consequence felt it to be its duty to give most careful attention to the subject, which it referred to a committee, whose report has been adopted and embodied in a by-law.

The privileged class consisted, as you are aware, of certain royal personages, peers of the realm, and Privy Councillors (Statutes, Sect. iv. cap. 1); and they were balloted for at any meeting of the Society, after a week's notice on the part of any Fellow, without a suspended certificate, or other form whatever.

The committee reported that it was desirable to retain the power of electing, as a "privileged class," persons who, while precluded by public duties or otherwise from meeting the scientific requirements customary in the case of ordinary Fellows, possessed the power and had shown the wish to forward the ends of the Society, and recommended that the class should be limited to the princes of the blood royal and members of her Majesty's Privy Council. And with regard to the method of election, they recommended that a prince of the blood royal might be publicly proposed at any ordinary meeting, and balloted for at the next; that, with regard to a member of her Majesty's Privy Council, he might be proposed at any ordinary meeting by means of a certificate prepared in accordance with chap. 1. Sect. iii. of the Statutes, membership of the Privy Council being the only qualification stated—the certificate being, with the Society's permission, suspended in the meeting-room till the day of election, which should fall on the third ordinary meeting after suspension.

Having regard to the eminent services to the State which have been rendered by Privy Councillors, and to the fact that all peers who do render such services are habitually enrolled on the list of Privy Councillors, it was believed by the Council that the effect of thus limiting the privileged class would be that the doors of the Society would remain open to all such peers as desire and deserve admission, but who have not the ordinary qualifications for fellowship; while all such peers as might appear with claims which compete with those of ordinary candidates would prefer owing the fellowship to their qualifications rather than to their birth.

The Council hopes that by this means the so-called privileged class will be reinforced, and that statesmen who may have considered themselves ineligible through want of purely scientific qualifications, or who have hesitated to offer themselves from the fear of interfering with the scientific claims of others, will in future come forward and recruit our ranks.

A passing notice of the manner of proposing candidates for the ordinary class of fellowship may not be out of place. Theoretically this is done by a Fellow who is supposed to be a friend of the candidate, is versed in the science on which his claims are founded, and is satisfied of his fitness in all respects for fellowship. It is most desirable that the Fellow who proposes a candidate should take upon himself the whole duty and responsibility of preparing the certificate, should sign it first, and himself procure the signatures of other Fellows in whose judgment of the candidate's qualifications the Council and the Society may place implicit confidence. It is unsatisfactory to see attached to a candidate's certificate an ill-considered list of signatures, whether given from personal or from general knowledge; and the happily rare practice of soliciting signatures and support, directly or indirectly, by the candidate himself, cannot be too strongly deprecated. For obvious reasons the president, officers, and other members of the Council have hitherto during their periods of office abstained from proposing a candidate of the ordinary class, or from signing his certificate, but have not withdrawn their signatures from certificates sent in before they took office. The Council and officers will probably not feel the same objection to signing the certificates of candidates of the privileged class, as these will not be selected for ballot by the Council, but will be elected by the Society at large at their ordinary meetings.

In carrying on the business of the Society the Council is much indebted to committees appointed annually for special purposes, or to whom an occasional question is referred. The annual appointments include the Government Grant, the Library, the Soirée, and the Acton Estate committees. The temporary committees of the past year have been the Circumnavigation, the Transit of Venus Expeditions, the Arctic, the House, the Brixham Cave, the Privileged Classes, and the Davy Medal committees. Besides these there are two permanent committees, the Meteorological and the Scientific Relief, to which fresh members are appointed as vacancies occur. From these designations, it will be understood that some of the committees have been occupied with questions connected with the Government service, while others have devoted themselves exclusively to the business of the Society.

I shall now mention such of the labours of these committees as seem to be most worthy of your attention.

The Meteorological Committee of the Board of Trade, as it ought to be called, discharges in all respects the most arduous and responsible duties of any, controlling as it does the whole machinery of the British Government for the making, registering, and publishing of especially oceanic meteorological phenomena throughout the globe.

The primary purpose for which this and all similar offices were established was the acceleration of ocean passages for vessels by an accurate investigation of the prevalent winds and currents. In other words, their great object is to aid the seaman in what Capt. Basil Hall called "one of the chief points of his duty"—namely, "to know when to find a fair wind, and when to fall in with a favourable current." The first impulse to the formation of an office for this purpose was given by the late General Sir J. Burgoyne, who in 1852 started the idea of land observations to be carried out by the corps of Royal Engineers.

Shortly afterwards our Government corresponded with the United States Government on the subject of co-operating in a scheme for land observations, which was followed by a suggestion on the part of America that the operations should be extended to the sea.

The correspondence was referred to the Royal Society, which warmly approved the scheme of sea observations, but saw many difficulties in carrying out that for the land. The Brussels Conference followed in 1853, when representatives of most of the maritime nations assembled and adopted a uniform plan of action. Soon after this, Lord Cardwell, then President of the Board of Trade, established the Meteorological Department of that office, and placed the late Admiral Fitzroy at the head of it—the Royal Society, at the request of the Government, supplying copious and complete instructions for his guidance, which were drawn up mainly by Sir Edward Sabine. Admiral Fitzroy's zeal and his great labours are known to all; he worked out the system of verifying and lending instruments, planning surveys, registering observations, publishing results; and, lastly, himself originated the plan of predicting the weather, and establishing storm-signals at the sea-ports along the coast.

On Admiral Fitzroy's death in 1865 the Royal Society was again consulted as to the position and prospects of the office. Its report, which did not differ materially from that of 1855, was in 1866 referred to a committee, composed of a representative of the Board of Trade, of the Admiralty, and of the Royal Society. This committee supported the previously expressed views of the Society, and suggested the placing of the office under efficient scientific superintendence; upon which the Society, in the same year, was requested by the Government to undertake the superintendence of what had been the Meteorological Department of the Board of Trade. To this request the Council of the Society so far acceded as to nominate a committee of eight Fellows (subsequently increased to ten) to undertake the entire and absolute control of the office; and a parliamentary grant of 10,000*l.* per annum was provided to maintain it.

This is in brief a history of the connection between the Royal Society and the Meteorological Office on the one hand, and between the office and the Government on the other. It is a very anomalous position, and has been greatly misunderstood. It has led to the misconception on the part of some that the Society controlled the office, and by others that the Government (Board of Trade) controlled it, and by more that the annual grant of 10,000*l.* is made to and in support of the Royal Society, or of its own objects, whereas the grant is paid direct to the director of the office as soon as voted. The Society's action is confined to the selection of the committee, which superintends the office, while the Board of Trade, leaving to the committee the details of their operations, exercise only a general control. The labours of the committee are entirely gratuitous, and no part of the 10,000*l.* is touched by them or by the Royal Society.

I believe there is no parallel to such an organisation as this in any other department of the Government. It has its advantage in securing to the office absolute freedom from that disturbing element in the public offices, that their heads are chosen partly on political grounds and change with every Government, and its disadvantage in wanting the support of direct Government authority and prestige. Hitherto, owing to the care of the committee, which meets almost weekly, to the zeal and efficiency of the director (who is also secretary to the committee) and of the Marine Superintendent, it has worked well. Into its working it is not my purpose to enter; its efficiency and value are fully acknowledged by the public. No more practical proof of this can be cited than the general desire, supported by memorials presented to Parliament, for the restitution of the storm-signals, which were discontinued after Admiral Fitzroy's decease, on the ground of their trustworthiness having been called in question. It is no little testimony to the foresight of that zealous officer that they are not only now re-established and in full working order at 100 stations on the coast of Great Britain, but that the very warnings issued from Paris to the coast of France by the Government of that country are actually sent to Paris from the Meteorological Office in London. The same warnings are transmitted along the whole European coast, from Norway to Spain; and the system has been extended to Italy, Portugal, and Australia.

The Kew Observatory, which is used also as the central observatory of the Meteorological Committee, is supported by a grant from that committee, and by the munificence of our Fellow, Mr. Gassiot, who has settled on it a fund which produces 500*l.* a year for the carrying on of observations chiefly magnetical.

The Circumnavigation Committee.—The scientific results of the *Challenger* Expedition have far exceeded our most sanguine anticipations. The Temperature Survey of the Atlantic may, as Dr. Carpenter informs me, be truly characterised as the most important single contribution ever made to Terrestrial Physics, presenting as it does the whole thermal stratification of an oceanic area of about 15 million square miles and with an average depth of 15,000 feet. Nor are the results of the Pacific Survey less important. Some of these were laid before you at our meeting of the 26th inst. in Prof. Wyville Thomson's "Preliminary Notes on the Nature of the Sea-Bottom in the South Sea," which reveal the existence of hitherto unsuspected processes of aqueous metamorphism at great depths in the ocean, and throw an entirely new light upon the geological problem of the origin of "azoic" clays and schists.

Valuable papers on new and little known marine animals have been contributed to our Transactions and Proceedings by Mr. Willemöes-Suhm, Mr. Moseley, and other members of the civilian scientific staff of the *Challenger*; and a number of the Journal of the Linnean Society is devoted to the botanical observations and collections made by Mr. Moseley during the course of the voyage.

Transit-of-Venus Committee.—Upon the representation of your Council, her Majesty's Government has attached naturalists to two of the astronomical expeditions sent out from this country to observe the Transit of Venus. The stations selected were the two most inaccessible to ordinary cruisers, and at the same time most interesting in regard to their natural productions—namely, the island of Rodriguez in the Mauritius group, and Kerguelen's Land in the South Indian Ocean.

The objects and importance of these appointments were laid before the Government in the following statement:—

"It is an unexplained fact in the physical history of our globe that all known oceanic archipelagos distant from the great continents, with the sole exception of the Seychelles and of a solitary islet of the Mascarene group (which islet is Rodriguez), are of volcanic origin. According to the meagre accounts hitherto published, Rodriguez consists of granite overlaid with limestone and other recent rocks, in the caves of which have been found the remains of recently extinct birds of a very singular structure. These facts, taken together with what is known of the natural history of the volcanic islets of Mauritius and Bourbon to the west of Rodriguez and of the granitic archipelago of the Seychelles to the north of it, render an investigation of its natural products a matter of exceptional scientific interest; which, if properly carried out, cannot fail to be productive of most important results.

"As regards Kerguelen's Land, this large island (100 by 50 miles) was last visited in 1840, by the Antarctic Expedition under Sir James Ross, in mid-winter only, when it was found to contain a scanty flora of flowering plants, some of which belong to entirely new types, and an extraordinary profusion of marine animals and plants of the greatest interest, many of them being representatives of north-temperate and Arctic forms of life.

"H.M.S. *Challenger* will no doubt visit Kerguelen's Land, and collect largely; but it is evident that many years would be required to obtain even a fair representation of its marine products; and though we are not prepared to say that the scientific objects to be obtained by a naturalist's visit to Kerguelen's Land are of equal importance to those which Rodriguez will yield, we cannot but regard it as in every respect most desirable that the rare opportunity of sending a collector to Kerguelen's Land should not be lost."

I may further state as a matter of great scientific interest, that Rodriguez contains the remains of a gigantic species of land-tortoise allied to those still surviving in some other islands of the Mauritius group, and that the nearest allies of these are the gigantic tortoises of the Galapagos Islands in the opposite hemisphere of the globe, as one of our Fellows, Dr. Günther, has shown in a paper read last session to the Society. Very valuable collections of these fossils have been made by Mr. Newton, the Colonial Secretary of Mauritius, during a brief stay which he was enabled to make in Rodriguez; but the materials are far from sufficient for obtaining all the information we want.

In accordance with your Council's recommendation, the Treasury sanctioned the appointment of four naturalists—three to Rodriguez, and one to Kerguelen's Land. Those sent out to Rodriguez are:—Mr. I. B. Balfour, son of Prof. Balfour, of Edinburgh, F.R.S., who, besides being educated as a botanist, has worked as a field geologist in the Geological Survey of Scotland; he is charged with the duties of botanist and geologist; Mr. George Gulliver, son of one of our Fellows and a pupil of Prof. Rolleston, in Oxford, who goes out as naturalist; and Mr. H. H. Slater, who has had great experience as a cave explorer, and who will devote his attention especially to the collection of fossils.

The Kerguelen's Land duties are undertaken by the Rev. A. E. Eaton, M.A., a gentleman most favourably known as an entomologist, and who had made very important collections in Spitzbergen, which he visited for the purpose of studying its fauna and flora. These gentlemen had, by the last accounts, all proceeded to their destinations.

(*To be continued.*)

FRENCH ACADEMY OF SCIENCES.—ANNIVERSARY MEETING

THIS Anniversary took place on the 28th December, the president being M. Faye, who delivered an able address, giving some interesting details as to the history of the prizes offered for competition by the Academy.

One of the first ever offered was a sum of 4,000*l.* given by Philippe d'Orleans, then Regent of France, in 1716, to be awarded to the person or persons who should invent a method of determining longitude at sea. This handsome sum was not awarded to anyone up to 1793, when the Academy was suppressed, M. de Choiseuil, French Ambassador to England, having made fruitless exertions on behalf of Harrison, the well-known chronometer maker, in 1763.

A circumstance connected with these old prizes is worth noting. La Condamine, about 100 years ago, offered a prize for an essay on the question "why so many differences of colour were noted between the male and female livery in quadrupeds as well as in birds." The question being deemed useless, the money was not accepted by the Academy.

In the last century almost all the prizes were won by Euler and Bernouilly, but now scarcely any of the prizes, amounting to 160*l.*, are awarded; sometimes nobody competes for them.

Although the distribution this year is both for 1872 and 1873, only two of the competitive prizes have been taken, one for 1873 by M. Mascart, professor in the Collége de France, for a paper on the modification which the light of the sun undergoes in consequence of the motion either of the sun or of the earth. M. Mascart failed to observe any modification, but the prize was given to him owing to the care and ingenuity displayed in his experiments. One prize was also won by M. Balbrain for a paper on the reproduction of animals that present parthenogenetic phenomena.

The proceeds of the 4,000*l.* offered by M. Breaut to the person who should discover a cure for the cholera was divided between several partly successful essayists for 1872 and 1873, but it is not likely that the sum itself will ever be parted with by the Academy.

The prizes offered for general excellence or voluntary work on a certain subject have been a great deal more fortunate, so that the method adopted by the Royal Society promises better results than the old academical competitive system, even in Paris. The Plumly prize of 120*l.* for the best paper on the improvement of steam navigation was gained for 1872 by M. Zaurines, who has carefully investigated propulsion by the Archimedean screw; in 1873 by M. Bertin, for a paper on the best method of ventilating steamers.

The Lalande prize in astronomy has been gained for 1872 by the brothers Henry for the discovery of a number of small planets at the Paris Observatory, and in 1873 by M. Coggia, of the Observatory of Marseilles, for his discoveries among comets.

The Poncelet prize has been given for 1872 to M. Mannheim for the general excellence of his geometrical disquisitions, and in 1873 to Sir W. Thomson for his magnificent works on the mathematical theory of electricity and magnetism.

The Godard prize for 1872 has been awarded to Dr. Pettigrew for his work "On the Muscular Arrangements of the Bladder and Prostate, and the manner in which the Ureters and Urethra are closed."

The aggregate sum to be awarded yearly, exclusive of the Breaut prize, is 4,400*l.*, and the number of prizes nineteen, only a few being for subjects specially proposed by the Academy. The competition is open to all nations. The names of competitors must be placed in sealed envelopes, which are opened only in the case of those who succeed; but, except in the case of prizes given for general excellence, papers must be written either in Latin or in French.

SCIENTIFIC SERIALS

Jahrbuch der k.k. geologischen Reichsanstalt. Band xxiv. Nos. 1 and 2.—The first article in No. 1 is by Dr. A. Redtenbacher, and treats of the stratigraphical relations of the mesozoic formations as developed in the district of Gams, near Hieflau. The second paper, by Dr. C. Doelter, gives some account of the Siebenbürgischen metalliferous mountains. The district described lies south of the river Arranyos, between Offenbánya and Bistra, as far as the Maros. The formations developed in this district consist of (1) crystalline, metamorphic, and eruptive rocks (gneiss, crystalline limestone, granite, diorite, syenite); (1) Jurassic and cretaceous (limestone, melaphyre and augite porphyry, sandstone, chalk, &c.); (3) Tertiary (comprising, besides various fossiliferous deposits, such igneous rocks as hornblende-andesite, augite-andesite, basalt); (4) alluvium. A sketch-map accompanies Dr. Doelter's communication.—Herr R. Hörnes contributes a paper entitled "Tertiary Studies," in which he gives an account of the mollusca met with in various Tertiary deposits (as at Kischeneff, Jenikale, &c.) A number of the species described are new to science. Four excellent plates illustrate the paper.—Dr. E. Mojsisovics, whose contributions to the *Jahrbuch* are both frequent and valuable, gives us a long paper on the Triassic period in the East Alps. He discusses the distribution of the Triassic fauna, and shows that the formation itself may be divided into zones, each characterised by certain well-marked species; further, he describes at length the nature of the deposits, and points out that the trias is characterised throughout by the constant presence of poorly fossiliferous limestone and dolomite and richly fossiliferous marl and calcareous marl.—The only geological paper in No. 2 is one by Dr. Guido Stache, On the palæozoic regions of the East Alps. The author describes in considerable detail the structure of the rock-masses forming the Alpine lands of Austria, and gives a coloured geological map of the regions described, and two plates of horizontal sections.—Amongst the mineralogical papers accompanying these numbers of the *Jahrbuch* may be noted one by Dr. Doelter, On the trachyte of the Siebenbürgischen metalliferous mountains, in which a number of analyses are given.—Herr Kalkowsky furnishes an account of the microscopy of the felsite and pechstein of Saxony.—A new mineral (Ludwigite) from Banat is described by Tschermak; and a

Report of the volcanic eruptions and earthquakes that took place during last year, is given by C. W. Fuchs. The latter author furnishes a translation from the Swedish of Nauckhoff's paper On the occurrence of native iron in a basalt vein at Ovifak, in Greenland, in connection with which we note also a paper by the editor (Tschermak) On the meteorite-find in Greenland.

Astronomische Nachrichten, No. 2015, contains a detailed statement of observations made at Washington by Cleveland Abbe on the position of Coggia's comet, together with the form of the tail, its length, and other details.—F. Tietjen gives elements of Dr. Paliser's planet (139), together with an ephemeris for November and December.

Memorie della Societa degli Spettroscopisti Italiani.—Father Secchi sends an account of his observations on the solar eclipse of October last. He observed the contacts of the limbs of the sun and moon by the spectroscopic method, and discusses its advantages over the ordinary method with the simple telescope. —The same author sends drawings of the chromosphere from December 26, 1873, to August 2, 1874, and he remarks on the continual diminution in the frequency and height of the prominences in accordance with the diminution in number of sun-spots. The sun appears to have been seen, on an average, rather oftener than every other day.

Annali di Chemica applicata alla Medicina, vol. lix, No. 3, September, opens with a paper in the Pharmaceutical Section by Prof. Borsarelli, of Turin, entitled "General and Comparative Study of the Pharmacopœias of Europe and America."—In the same section is a paper by Dr. C. Girard, On protoxalate of iron, and one by Leger, On a tartrate of magnesium lemonade. —In Hygiene there is a paper by Cunningham, On the microscopical examination of the air.—Drs. Lanzi and Terrigi communicate a paper to the Pathological Section, on palustrine miasma.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, Dec. 17.—Dr. Allman, president, in the chair.—The President read a paper on the Diagnosis of new Genera and Species of Hydroids. Several very interesting collections of Hydroida had recently been placed in the author's hands for determination. One of the most important of these is from the zoological museum of the University of Copenhagen, and consists entirely of gymnoblastic forms obtained from various parts of the world, but principally from the Scandinavian shores. The author is indebted for it to Prof. Lütken, of the University of Copenhagen. Another collection, consisting of calyptoblastic forms, was made in the Japan seas by Capt. St. John, of H.M.S. *Sylvia*, and sent to the author for determination by Mr. J. Gwynn Jeffreys, by whom it is destined for the British Museum. For another valuable collection, containing many new species, the author is indebted to Mr. Busk; while a collection, belonging chiefly to the family of Plumularidæ, was made by Mr. Holdsworth in Ceylon, and contains several curious forms; and, lastly, for a small collection from the shores of Spitzbergen, the author is indebted to the Rev. Mr. Eaton, by whom it was obtained during a recent yacht voyage to that region. Among the new species from the Copenhagen Museum, one of the most interesting is a Hydractinia, from Spitzbergen. It is distinguished from *H. echinata* of our own shores by its nearly smooth spines, but more especially by the peculiar condition of its gonosome, the blastostyles being destitute of the capitulum which forms so characteristic a feature in *H. echinata*, while each carries only a single spherical sporosac of comparatively enormous size. He proposes for it the name of *H. monocarpa*. The same collection contains a new Cladocoryne, the second species as yet discovered of this remarkable genus. It was found attached to Gulf-weed, and is especially interesting in being provided with its reproductive zooids, structures hitherto unknown in the genus. These are developed among the tentacles, and are almost without doubt medusiform, though this point could not be determined with absolute certainty. For the new species the name of *C. pelagica* was proposed. Another hydroid from the same collection was a beautiful Amalthæa, a genus nearly allied to Corymorpha. It was obtained from Iceland. One of its most striking features consists in the great length of its proximal tentacles; these are nearly as long as the entire stem round which, in the living animal, they must have hung down in the form of a graceful inverted tassel of flexile filaments subject to the impulse of every passing current of the surrounding water. The name of *A. islandica* was proposed for it. The Japan collection contained, among other interesting species, a Campanularia, remarkable for the comparatively enormous size of its cups, which exceeded by about five times the dimensions of those of the largest British species. It was named *C. grandis*. This collection contained also a beautiful Thuiaria, for which the name of *T. coronata* was proposed, and in which the female gonangium or receptacle for the ova was crowned by about nine very long bifurcating hollow spines, which formed a cage-like chamber into which the ova subsequently passed. An extension of the cœnosarc is continued from the enlarged summit of the blastostyle or fleshy columnar axis of the gonangium through the whole length of the spines; and as the blastostyle must be homologically regarded as a hydranth arrested and adapted to functions connected with reproduction instead of nutrition, the author looked upon the spines as representing the tentacles of a hydranth which had lost their prehensile functions, become clothed with chitine, and adapted to the protection of the ova during an early period of their development. Mr. Busk's collection contained many beautiful new species of calyptoblastic hydroids. Among these was a Sertularella, whose tubular hydrothecæ, free from the stem in nearly their entire length, were deeply cleft at their distal ends, in the manner of a mitre. For this curious species the name of *S. episcopus* was proposed. A new genus, under the name of *Gemminella*, was constituted for a sertularia-like form, in which the hydrothecæ, instead of being situated on the opposite sides of the stem, were all brought to the front of the stem, and there became adnate to one another in pairs. A beautiful Thuiaria, with a remarkable dichotomous ramification of the main stem, and with the gonangia situated in the axils of the branches, presented a striking resemblance to the inflorescence of certain common caryophyllaceous plants, and was named *T. Cerastium*. Mr. Holdsworth's collection, made on the coast of Ceylon, contains some very remarkable species. Among these is a magnificent Plumularian of the Aglaophenian type, rendered striking by the great length of its mesial nematophores, and by the presence of two very long divergent teeth which project from the margin of the remarkably patulous hydrothecæ. The species grows in the form of crowded tufts of beautifully graceful plumes. It would seem to belong to the group which Kirchenpauer places in his sub-genus Makrorynchia, and the name of *Makrorynchia insignis* is now proposed for it; but as no gonosome has as yet been found in any of the specimens, the generic name is only provisionally assigned to it. For another beautiful form from the same collection the author has constituted a new genus under the name of *Taxella*. Its hydrothecæ and nematophores are formed on the type of those of the genus Aglaophenia, but its gonophores are not protected by corbulæ, and its ramification presents the peculiarity of being doubly pinnate, so that it represents in the Aglaophenia section of the Plumularidæ a form which in the Plumularian section is represented by the genus Diplopteron, a genus recently constituted by the author for one of the deep-sea hydroids of the *Porcupine* Exploring Expedition. The name of *Taxella eximia* is assigned to the present species, which grows in dense tufts to the height of about a foot. In Mr. Eaton's collection, from Spitzbergen, the only well-preserved hydroid is a little Sertularia with regularly pinnate ramification, elongated hydrothecæ, and a long ovate gonangium curiously constricted near its middle. The author gives it the name of *S. arctica*.

Geologists' Association, Dec. 4.—Henry Woodward, F.R.S., president, in the chair.—Dr. W. B. Carpenter, F.R.S., On the conditions which determine the presence or absence of animal life on the deep-sea bottom.

EDINBURGH

Royal Society, Dec. 21.—Prof. Kelland, vice-president, in the chair.—The following communications were read:—Remarks on the great logarithmic table computed at the Bureau du Cadastre under the direction of M. Prony, by Mr. Edward Sang.—On the elimination of α, β, γ, from the conditions of integrability of S. $U\alpha\delta\rho$, S. $U\beta\delta\rho$, S. $U\gamma\delta\rho$, by M. G. Plarr. Communicated by Prof. Tait.—The development of the ova and structure of the ovary in the Mammalia, by James Foulis, M.D. Communicated by Prof. Turner.—Mathematical Notes, by Prof Tait:—(1), On a singular theorem given by Abel; (2), On the equipotential surfaces for a straight wire; (3), On a fundamental principle in Statics,

MANCHESTER

Literary and Philosophical Society, Dec. 1.—Rev. Wm. Gaskell, M.A., vice-president, in the chair.—Some doubts in regard to the law of the diffusion of gases, by Mr. H. H. Howorth.

Dec. 15.—Mr. Edward Shunck, F.R.S., president, in the chair.—Rev. Wm. Gaskell, M.A., read an interesting account of Horrocks' and Crabtree's observations of the Transit of Venus in 1639, published in the *Annual Register* for 1769.—Some particulars respecting the negro of the neighbourhood of the Congo, West Africa, by Mr. Watson Smith, F.C.S.—Analysis of one of the Trefriw mineral waters, by Mr. Thomas Carnelley, B.Sc. Communicated by Prof. H. E. Roscoe, F.R.S.

GLASGOW

Geological Society, Dec. 15.—Mr. John Young, F.G.S., vice-president, in the chair.—Mr. James Neilson, jun., exhibited a selection of fossils from the Irish and Scotch limestone beds, and read a paper on the Armagh limestones, and their equivalents in Scotch strata.—Mr. James Dairon read a paper on the graptolites of the Upper Llandeilo rocks of the south of Scotland. Mr. Dairon described more particularly the following forms: *Climacograpsus teretiusculus*, *Didymograpsus*, *Dicranograpsus*, and *Pleurograpsus*, pointing out the characteristic features of each, and indicating their range in the rocks of the formation, and the beds in which they severally occur most abundantly. The paper was illustrated by drawings and by a beautiful collection of specimens.

BOSTON, U.S.

Society of Natural History, March 18.—The president in the chair.—Dr. Samuel Kneeland read a paper illustrated by diagrams and specimens, on the evidence for and against the so-called sea-serpent. He thought a careful weighing of the evidence showed that such an animal is not a zoological absurdity, and that from palæontology (if we discard the testimony of many credible witnesses) we may even conclude that it is a possibility—and, he believed, a probability—that some form, intermediate between the marine saurians of the Secondary and the elongated cetaceans of the Tertiary has come down to the present epoch, and will eventually come under the notice of naturalists, and prove, in this as in many other cases, that widely spread popular beliefs in natural history, especially when professing to rest upon credible testimony, have generally for their foundation some portion of scientific truth. He believed there were at least two species of the creature (which he styled Eremotherium), one in the northern and another in the southern ocean.—Notes on Ophidiidæ and Fierasferidæ, with descriptions of new species from America and the Mediterranean, by F. W. Putnam.

PARIS

Academy of Sciences, Dec. 21.—M. Frémy in the chair.—The following papers were read:—New theory of the motion of the planet Neptune; remarks on the *ensemble* of the theories of the eight principal planets, Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, and Neptune, by M. Le Verrier. The paper presented completes a work commenced on September 16th, 1839.—New theorems on series of similar triangles, by M. Chasles.—On the limited oxidation of the hydrocarbons amylene, by M. Berthelot. The author employs a solution of chromic acid as the oxidizing agent. Hydride of amylene yields valerianic acid. Amylene when mixed with water and heated with the mixture yields a mixture of all the fatty acids from formic to valerianic—the latter and acetic acid being formed in the greatest proportions.—New documents on the flora of New Caledonia, by M. Ad. Brongniart.—On the carpellary theory according to the Liliaceæ, by M. A. Trécul.—The Laboratory of Experimental Zoology at Roscoff, by M. H. de Lacaze-Duthiers. The author gives a detailed account of this valuable establishment.—Micrometric measurements of the triple star ζ Cancri, by M. Otto Struve.—Report on a memoir by M. Sarrau, entitled, "Theoretical researches on the effects of gunpowder and explosive substances," by the Commissioners, MM. Morin, Tresca, Berthelot, and Resal.—On an apparatus for measuring gases in industrial analyses or *gas hydrometer*, by M. E. J. Maumené.—Observations concerning a recent communication by M. A. Cornu on the degree of precision of Foucault's method for measuring the velocity of light; a letter from M. Lissajous to the perpetual secretary. The writer gave the following extract from Foucault in contradiction to M. Cornu's statement that the former had obtained results having an indeterminate approximation: "Increasing thus the length of the luminous path and applying greater accuracy to the measurement of the time, I obtained determinations of which the extreme variations do not exceed $\frac{1}{100}$ and which combined by the method of means rapidly give series which ageee nearly to $\frac{1}{500}$."—On the pyruvic ureides: synthesis of parabanic acid, by M. E. Grimaux. This acid has been obtained by the action of bromine and water on mononitropyruvic ureide:—

$$C_4H_3(NO_2)O_2 + 6Br + H_2O = CBr_3NO_2 + C_3H_2N_2O_3 + 3HBr.$$

On a fragment of cranium seeming to indicate that trepanning might have been employed among the Celtic people, by M. E. Robert.—M. Dumas read a telegram from M. Fleuriais relating to the transit of Venus.—Installation in Campbell's Isle of the expedition sent to observe the transit of Venus, a letter from M. A. Boquet de la Grye to M. Dumas.—Letter to the perpetual secretary on the subject of the obelisk raised at Montmartre in 1736 for the fixing of the meridian of Paris, by M. F. Lock.—On the first method given by Jacobi for the integration of equations to the partial derivatives of the first order, by M. G. Darboux.—On the changes of brilliancy of Jupiter's satellites, by M. C. Flammarion.—On the molecular equilibrium of solutions of chromic alum, by M. Lecoq de Boisbaudran.—Preparation of pure nickel salts from the nickel of commerce, by M. A. Terreil.—Action of chlorine on perbromide of acetylene, by M. E. Bourgoin.—Toxicological search for potassium cyanide in presence of non-toxic double cyanides, by M. E. Jacquemin.—Researches on the pathological albumens, method of estimating albumens, &c., by J. Briot.—Analysis of a meteorite which fell in the province of Huesca, in Spain, by M. F. Pisani.—Observations relating to the Kodaı meteorite, by M. Daubrée.—Researches on the modifications which the blood undergoes in its passage through the spleen, from the double point of view of its richness in red globules and its respiratory capacity, by MM. L. Malassez and P. Picard.—Observations made at Bordeaux of two lunar halos of remarkable intensity on the 15th and 19th of December, a letter from M. G. Lespiault to the president.—During the meeting M. Du Moncel was elected a free member in place of the late M. Roulin.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—A Sketch of Philosophy, Part 4: Biology and Theodicy; a Prelude to the Theology of the Future: John G. Macvicar, M.A., LL.D., D.D. (Williams and Norgate).—Gardeners' Year Book for 1875: Robert Hogg, LL.D., F.L.S. (Journal of Horticulture).—Heredity. From the French of Th. Ribot (H. S. King and Co.).—Geology of the Clyde Valley: John Young, M.D. (James Maclehose, Glasgow).—List of the Palæozoic Fishes. Extracted from the Geological Magazine (Trübner and Co.).—Seventh Annual Report of the Executive Committee of the Manchester National Society for Women's Suffrage (Alexander Ireland, Manchester).—Notes on a Till or Boulder Clay with broken Shells in the Lower Valley of the River Endrick: Robert L. Jack, F.G.S. (Geological Society, Glasgow).—Astronomy: J. Norman Lockyer (Macmillan and Co.).—The Physics and Philosophy of the Senses: R. S. Wyld, F.R.S.E. (Henry S. King and Co.).—Cholera: How to Prevent and Resist it: T. Whiteside Hime, A.B., M.B., &c. (Baillière, Tindall and Cox).—Studies on Biogenesis: Wm. Roberts, M.D. (Royal Society).—On the Connection between Colliery Explosions and the Weather in 1872: Robert H. Scott and Wm. Galloway (Quarterly Journal of the Meteorological Society).—British Wild Flowers, Parts 7 and 8: John E. Sowerby (John Van Voorst).—History of British Birds, Part 6, 7 and 8: A. Newton, M.A., F.R.S. (John Van Voorst).—Micrographic Dictionary, Parts 18, 19, 20, and 21: J. W. Griffith, M.D., and A. Henfrey, F.R.S., F.L.S. (John Van Voorst).—Anthropologia, Vol. 1, Part (Baillière, Tindall, and Cox).

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